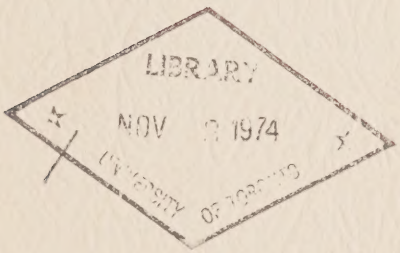
Environnement Canada

Guide to Data Holdings



INLAND WATERS DIRECTORATE,
ELECTRONIC DATA PROCESSING COMMITTEE,
OTTAWA, CANADA, 1973.

Environment Canada
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[G-3]

Guide to Data Holdings

Including a List of Variables Measured and the Data Bases in which they are stored

(13)

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Contents

1.0 How to Use this Publication

The Guide to Data Holdings in the Inland Waters Directorate is designed to provide convenient access to these data. The user can find here which data systems are operating in the Inland Waters Directorate, what kinds of data are available, where and how to obtain them, and whatever analytical capability goes with the data. This publication is organized on the following lines:

Introduction

A brief account of the Electronic Data Processing Committee's project for developing a rapid and comprehensive service to users of water resources data.

Descriptions and Titles of Data Banks or Systems

These are given under the following headings:

Physiographic Data
Streamflow and Water Level
Groundwater
Glaciology
The Great Lakes
Water Quality
Sediment
Use of Water Resources
Planning and Management (scientific documentation)

These nine sections outline the procedures for collecting and processing each type of data, the availability of data, the periods covered and the extent of the coverage, the kinds of institutions and individuals who are currently using them, and any developments planned for the data systems.

List of Parameters Measured

An alphabetical list of "variables" which presents the measurements, observations and synthesized data currently available, with a reference to the data bases from which they may be obtained. References to scientific documents on various aspects of water resources are not included as keywords, since this would make the alphabetical list far too extensive. Detailed references and search assistance is available through WATDOC (see page 88).

Other Information

The Guide contains two other lists - addresses for enquiries about data holdings and data publications of the Inland Waters Directorate.

Specific Data

The user may obtain specific data through the following means of identification.

Through the alphabetical list of "variables" (pages 100-110) the user is guided to one or more of the data bases holding these variables. He may then obtain information on the availability of data by describing the type of data required and indicating the location - Basin or Sub-Basin, Map or Square Grid Reference, Unit (district, point or station) or Title of Project. These enquiries should be addressed to the appropriate branch, division, section or office of the Inland Waters Directorate (see "Addresses").

If in doubt, write to the Electronic Data Processing Committee, Inland Waters Directorate, Environment Canada, Ottawa, Ontario, K1A 0E7.

2.0 Introduction

There are more data today than there were yesterday, and there will be even more tomorrow. The same may be said of data systems and banks, which have been springing up in recent years to cope with the relentless growth in the amount and variety of information to be handled. But, to state one more obvious fact, the capacity of systems to handle information in even more sophisticated ways is only a partial and costly achievement, unless the potential users know what information exists and how to acquire access to it.

The planning and management of water resources, with all their ramifications, are a good example of a field that already has several functioning data systems at its disposal, and now needs to open up more fully the channels of communications between the systems and with the people they are intended to serve. The publication of this Guide represents the first attempt to improve data accessibility on a national scale.

This program of development is being carried out by the Committee on Electronic Data Processing (EDP) of the Inland Waters Directorate, Environment Canada. The planning stage began with some studies undertaken for Inland Waters following the establishment, in 1966, of a working group on water data storage in the Department of Energy, Mines and Resources. An independent review of the Committee, in 1969, resulted in a set of recommendations (1) being made for co-ordinating the various data systems. A 1972 report (2), while supporting a co-ordinated approach, advocated the continuance of separate systems for the various categories of data, while rejecting the hasty introduction of a single comprehensive system on the grounds of its prohibitive cost, the complexity and diversity of the data, and the special needs of each of the present systems. This means that the systems individually would continue to be responsible for their own planning, management and research.

In the meantime, it is hoped that the present publication will help users to find the information they need. The Guide is designed to be updated as the data holdings change and increase.

References

1. Computer Science Division, Department of Energy, Mines and Resources, Report on *Co-ordination of Inland Waters Branch Water Resources Data,* 1969 (unpublished report).
2. Inland Waters Committee on Electronic Data Processing, *Report on Co-ordination of Data Systems,* April 1972 (unpublished report).

3.0 Physiographic-Hydrologic Data (Hydrologic Square Grid System)

3.1 Hydrologic Square Grid Data System*

Large quantities of data are collected and stored in various data banks, such as those of Water Survey of Canada and the Atmospheric Environment Service. However, the usefulness of all these primary data is increased considerably through combinations and correlations which could make relevant secondary data available. This is the intended role of the physiographic data bank, which incorporates the Hydrologic Square Grid Data System (1).

Recent hydrometric network planning studies, conducted by the Water Resources Branch, have led to the conclusion that maximum efficiency in hydrologic data transfer or indirect estimation of hydrometric data is achieved by storing in a computerized bank all data regarding hydrology, meteorology and physiographic characteristics, processing these data by means of statistical, deterministic or combined techniques, and transferring information on this basis to areas where data are missing (2).

3.2 Components

The four main components of the data bank are:

(i) space-time reference system,
(ii) data storage,
(iii) data processing,
(iv) information transfer techniques

The space-time reference system contains two elements. Firstly, a square grid, or matrix of squares, covers the area investigated, and it corresponds to the Universal Transverse Mercator (UTM) reference system. Squares of 10 x 10 kilometers have been used except for Southern Ontario, where a 5 x 5 km square was used. Each square can be identified by an index number of row and column (I, J), by its latitude and longtitude, or from the Universal Transverse Mercator system. This part of the reference system also indicates whether the square is entirely within the continental area or partially on the sea.

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* The system described here is still in the developmental stage, hence most of the information contained in it is not readily available. The extraction of requested information may, in some cases, require a considerable amount of time and effort.

The second element of the reference system is a technique (still being developed) for identifying the water runoff path from the divide between basins to the sea. This technique assists in establishing, at any point of the area, the drainage system above the point.

Data storage consists of physiographic data stored in each square, and meteorologic and hydrologic data stored in the squares in which stations are located. The present physiographic records consist basically of the elevation of the southwest corner of the square, the percentage of the square covered by forest, marshes, lakes, barren land, urbanized land, agricultural land, and sea; and in some areas, where available, an index of soil permeability.

Meteorologic data are limited at present to monthly temperature and precipitation time series at stations located in the area.

Hydrologic data at present consist of daily streamflow and sediment time series at stations in the study area.

The data processing component contains three groups of operations:

(i) computation of "derived" physiographic characteristics such as slopes, barrier heights, distance to oceans and shield factors in the eight principal compass directions for each square.

(ii) computation of statistics; physiographic characteristics of various river basins.

(iii) analysis of meteorologic and hydrologic data, and estimation of long-term, annual, monthly and daily means, and other statistics of these values.

The information transfer techniques comprise statistical and deterministic models, which are based mainly on the combined use of physiographic and meteorologic, physiographic and hydrologic, or all three groups of data to produce estimated information for any point (or square) or basin within the study area. Figure 3.2-1 (a digital map) is a sample showing the distribution of average runoff.

3.3 Procedures

The physiographic characteristics have been extracted from topographic survey maps, in conjunction with engineering consulting firms.

Daily hydrologic and meteorologic data have been obtained from Water Survey of Canada (WSC) and the Atmospheric Environment Service (AES). Monthly averages of streamflow, temperature and precipitation, with daily maximum and minimum streamflow per month, were calculated and stored in the bank.

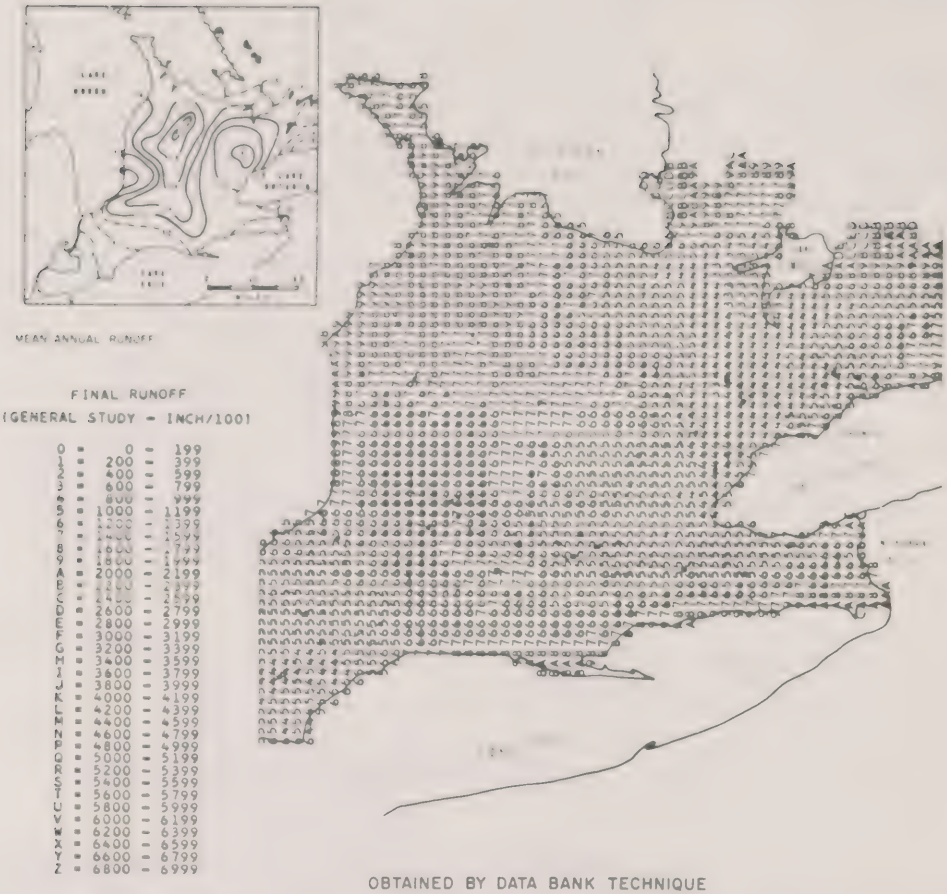

Figure 3.2-1. Digital map of the distribution of annual runoff in southern Ontario.

Correlations between the respective data sets and the physiographic characteristics have synthesized missing data for both the hydrologic and meteorologic data files.

3.4 Availability*

Data in the physiographic data bank can be summarized as follows:

(i) measured physiographic data are in grid square format for all of Canada except northern Ontario and the Arctic Archipelago (see Figure 3.4-1).

(ii) derived physiographic characteristics.

(iii) derived hydrologic data, e.g., average annual streamflow for ungauged basins.

(iv) base data, i.e., streamflow, sediment, precipitation and temperature as recorded by WSC and AES. However, it is preferred that the prospective user obtain them from the source agency.

Enquiries should be directed to the Head, Network Planning and Forecasting Section, Applied Hydrology Division, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario. (Telephone 819-997-1509).

3.5 Users

The data have been used mostly so far in estimating hydrologic data for hydrometric network planning. The users have included engineering study groups in the federal government, district offices of Water Survey of Canada and university research groups.

A potential use is in estimating streamflow data at ungauged stations.

3.6 Plans

A system of larger squares for areas of smooth terrain, combined with smaller squares for more rugged terrain, could be incorporated into the present system. This would also provide some flexibility in application. Such a system is being investigated in British Columbia.

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* As noted earlier, this information is not in a readily available form and may, in some cases, require considerable effort to extract it in desirable form.

Figure 3.4-1. Square grid coverage in Canada.

As shown on Figure 3.4-1 the square grid system is at present composed of four geographic units: Western and Northern Canada, Southern Ontario, Quebec and Atlantic Provinces. There are minor differences between the physiographic parameters stored in each of these four units and also, in some cases, between the information transfer components. The feasibility of combining these four units into one large unit will be investigated. The development of physiographic square grid data for northern Ontario is also planned.

3.7 References

1. Solomon, S.I., J.P. Denouvilliez, E.J. Chart, J.A. Woolley, and C. Cadou. *The Use of a Square Grid System on Computer Estimation of Precipitation, Temperature and Runoff.* Water Resources Research, Vol. 4, No. 5, October 1968.

2. The Shawinigan Engineering Company Limited, *Hydrometric Network Planning Study for Western and Northern Canada*, November 1970. Report for Government of Canada, Department of Energy, Mines and Resources, and other reports in this series.

4.0 Streamflow and Water Level (Hydrometric System)

4.1 Automated Hydrometric Data System

Water Survey of Canada and its predecessors have been collecting and publishing streamflow and water level data for over 60 years. The present hydrometric network consists of more than 2,400 gauging stations, excluding those in Quebec, where the provincial government has conducted its own surveys since 1964 (see Table 4.1-1).

Automated data processing techniques were initiated in Water Survey of Canada in 1966 along two fronts:

(i) automation of daily discharge computations with the use of a digitizer,

(ii) storage of historical daily discharge data on magnetic tape.

Both of the above programs are now in operation.

To date, over 30,000 station-years of daily discharge data have been collected, and about 8,000 station-years of "water level only" data. All of these data are published, and daily discharge data are available on magnetic tape for computer processing.

4.2 Procedures

Hydrometric data are collected and computed by the staffs of Water Survey of Canada's district offices at Vancouver, Calgary, Regina, Winnipeg, Guelph and Halifax, and an area office at Montreal. The data are forwarded to Ottawa for publication. Water level data are obtained by means of either an automatic graphical recorder (usually a Stevens A35 type) or a manual gauge, such as a vertical staff gauge, which is usually read once a day.

About 10 discharge measurements are obtained annually at each stream-flow gauging station location, from which the daily discharge data are computed. These measurements, which are not made available to the user in a regular series of publications, consist of the following physical observations

(i) depth of water for at least 20 points to obtain the cross-sectional area,

Table 4.1-1 Water Survey of Canada

Gauging Stations, December 31, 1972

Province or Territory	Total Active	Flow	Levels Only
Yukon Territory	37	31	6
Northwest Territories	63	44	19
British Columbia	657	540	117
Alberta	426	351	75
Saskatchewan	305	237	68
Manitoba	316	217	99
Ontario	437	387	50
Quebec	36	17	19
New Brunswick	79	70	9
Nova Scotia	44	43	1
Prince Edward Island	11	11	0
Newfoundland	43	43	0
TOTAL	2,454	1,991	463

(ii) velocity of water at each vertical where the depth is obtained,

(iii) air and water temperature at the time of measurement,

(iv) ice thickness in the section.

Most of the data for stations equipped with a graphical recorder are computed by using a "pencil follower", which, in conjunction with a local digital computer, gives the daily values on punched cards. Data for stations not equipped with a recording gauge can be computed by using another computer program whose output also gives daily values on punched cards. The data from the remaining stations are computed manually or are supplied by outside agencies, and the values are keypunched from the source documents.

There are 36 cards per station-year of data. These cards are converted to magnetic tape at the district office and the tape is sent to Ottawa. The tapes from all districts are then merged on a single tape for the current year and, along with data from Water Survey of Canada's HYDEX and PEAKS magnetic tape files, are converted by a commercial computer system into photocopy manuscript, which is directly suitable for publication. The tape containing the one year of daily discharges for all stations is then merged with the 16 master tapes containing historical data to produce updated tapes.

4.3 Availability

Daily discharges and daily water levels are published annually in the "Surface Water Data" series. Figure 4.3-1 shows a sample page from this publication. The format is explained in each of the following editions of the publication: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario (including stations operated by Water Survey of Canada in Quebec), Quebec (English translation of the province's French edition), Yukon Territory — Northwest Territories, and Atlantic Provinces.

A "Surface Water Data Reference Index" is also published annually (see Figure 4.3-2 for sample page).

A third type of publication is an "Historical Streamflow Summary". This contains monthly and annual discharges for those stations where five or more years of data have been collected; the annual maximum and minimum daily discharges; the annual maximum instantaneous discharges; and the annual total discharges in acre-feet. The summary, which is to be issued every five years, presents the data to 1970 in the first issue (see Figure 4.3-3 for sample page).

Publications for streamflow and water level data are available from Information Canada, from the Publications Office, Inland Waters Directorate, or the Data Control Section, Water Resources Branch, Inland Waters Directorate,

KINASKAN LAKE NEAR TELEGRAPH CREEK STATION NO. 08CG002

DAILY WATER LEVEL IN FEET FOR 1970

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.73	1.51	1.37	1.17	1.22	2.22	3.99	3.53	2.75	2.33	2.18	1.65	1
2	1.75	1.50	1.34	1.15	1.23	2.35	3.97	3.56	2.74	2.34	2.16	-	2
3	1.75	1.48	1.33	1.17	1.24	2.62	3.96	3.58	2.75	2.40	2.14	-	3
4	1.75	1.50	1.35	1.16	1.24	3.00	3.97	3.62	2.74	2.46	2.13	1.68	4
5	1.73	1.49	1.33	1.16	1.28	3.29	3.99	3.61	2.70	2.43	2.09	1.65	5
6	1.69	1.48	1.33	1.17	1.29	3.43	3.99	3.57	2.66	2.48	2.07	1.72	6
7	1.68	1.50	1.31	1.15	1.32	3.62	3.96	3.57	2.67	2.46	2.03	1.69	7
8	1.68	1.49	1.34	1.16	1.35	3.69	3.94	3.60	2.65	2.47	2.01	1.70	8
9	1.68	1.50	1.30	1.15	1.40	3.70	3.87	3.59	2.60	2.45	1.97	1.72	9
10	1.69	1.49	1.30	1.15	1.44	3.73	3.81	3.56	2.56	2.41	1.95	1.74	10
11	1.66	1.48	1.29	1.15	1.47	3.81	3.74	3.52	2.55	2.42	1.98	1.75	11
12	1.66	1.51	1.29	1.14	1.51	3.83	3.66	3.48	2.53	2.42	1.96	1.76	12
13	1.65	1.46	1.28	1.13	1.58	3.82	3.62	3.46	2.51	2.42	1.92	1.84	13
14	1.65	1.44	1.28	1.13	1.68	3.84	3.52	3.41	2.49	2.38	1.91	1.83	14
15	1.67	1.44	1.23	1.14	1.71	3.90	3.51	3.37	2.48	2.39	1.90	-	15
16	1.65	1.43	1.25	1.12	1.76	3.99	3.54	3.37	2.44	2.35	1.88	-	16
17	1.65	1.44	1.26	1.12	1.80	4.08	3.53	3.32	2.44	2.34	1.86		17
18	1.65	1.41	1.25	1.12	1.82	4.16	3.53	3.26	2.42	2.38	1.83	-	18
19	1.67	1.40	1.24	1.12	1.84	4.20	3.51	3.23	2.39	2.35	1.81		19
20	1.67	1.43	1.23	1.13	1.88	4.21	3.54	3.17	2.39	2.34	1.78		20
21	1.65	1.44	1.22	1.12	1.88	4.25	3.58	3.11	2.36	2.31	1.75	-	21
22	1.62	1.40	1.23	1.13	1.91	4.44	3.54	3.11	2.37	2.29	1.70		22
23	1.60	1.37	1.22	1.12	1.94	4.47	3.51	3.06	2.34	2.27	1.68		23
24	1.60	1.38	1.21	1.13	2.00	4.51	3.49	3.03	2.33	2.24	1.65	-	24
25	1.59	1.40	1.22	1.14	2.04	4.50	3.47	2.98	2.32	2.21	1.60		25
26	1.58	1.38	1.22	1.15	2.06	4.37	3.43	2.91	2.32	2.19	1.60	1.74	26
27	1.57	1.38	1.22	1.14	2.06	4.33	3.41	2.89	2.29	2.15	1.59	-	27
28	1.56	1.34	1.19	1.15	2.12	4.24	3.44	2.88	2.33	2.13	1.55		28
29	1.54		1.19	1.16	2.13	4.16	3.48	2.85	2.31	2.19	1.54		29
30	1.54		1.19	1.18	2.16	4.07	3.47	2.79	2.34	2.15	1.52	1.75	30
31	1.52		1.19		2.19		3.50	2.76		2.18		-	31

SUMMARY FOR THE YEAR 1970

MAXIMUM DAILY WATER LEVEL, 4.51 FT ON JUN 24
MINIMUM DAILY WATER LEVEL, 1.12 FT ON APR 16

TYPE OF GAUGE MANUAL
LOCATION - LAT 57 32 08 N
LONG 130 12 37 W

NATURAL FLOW

WATER LEVELS ARE REFERRED TO ASSUMED DATUM.

KISKATINAW RIVER NEAR FARMINGTON STATION NO. 07FD001

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1970

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	133 B	22.9 B	27.8 B	60.8 B	595	585	257	174	16.7	27.0	33.3	16.9 B	1
2	127 B	22.3 B	27.3 B	70.1 B	676	533	325	172	25.8	25.9	33.7	16.8 B	2
3	124 B	22.1 B	26.5 B	85.4 B	823	490	299	147	33.9	26.6	32.7 B	16.4 B	3
4	116 B	22.0 B	25.2 B	102 B	837	444	266	126	35.7	25.8	31.8 B	15.7 B	4
5	102 B	22.2 B	24.0 B	134 B	797	404	232	107	34.9	30.5	31.3 B	15.4 B	5
6	93.7 B	22.8 B	22.9 B	181 B	775	361	207	88.8	31.5	42.0	30.6 B	15.2 B	6
7	89.8 B	23.3 B	22.7 B	227 B	754	324	190	85.5	31.3	29.4	30.3 B	15.1 B	7
8	85.0 B	24.0 B	22.8 B	455 B	691	303	158	81.4	38.7	27.7	30.0 B	15.2 B	8
9	74.7 B	24.9 B	23.2 B	560 B	637	295	140	62.1	40.7	27.0	29.7 B	15.6 B	9
10	71.9 B	25.5 B	23.7 B	642 B	619	288	122	50.5	18.7	28.0	29.0 B	15.8 B	10
11	68.0 B	25.0 B	23.9 B	685 B	626	285	107	49.0	35.3	28.6	28.7 B	16.0 B	11
12	59.9 B	22.7 B	24.1 B	706 B	807	298	93.7	49.8	32.7	31.4	28.6 B	16.3 B	12
13	46.7 B	22.1 B	24.4 B	732 B	1020	312	81.8	48.5	31.0	32.9	28.0 B	16.3 B	13
14	41.2 B	21.2 B	25.1 B	764 B	945	283	71.1	45.6	30.2	34.9	27.1 B	16.0 B	14
15	37.0 B	21.1 B	26.5 B	790	872	260	59.8	40.3	29.4	38.5	27.2 B	15.6 B	15
16	34.4 B	20.3 B	28.1 B	839	857	236	52.3	35.4	28.8	39.3	27.4 B	15.3 B	16
17	31.5 B	19.7 B	29.8 B	861	1270	218	47.9	31.8	28.7	38.3	27.2 B	15.0 B	17
18	28.8 B	21.1 B	30.4 B	970	2510	201	43.6	32.6	28.7	37.7	26.0 B	14.9 B	18
19	26.6 B	22.0 B	31.2 B	1040	2190	184	39.9	31.3	28.6	37.1	25.0 B	14.8 B	19
20	22.7 B	23.4 B	31.8 B	1080	1710	164	37.0	28.6	28.4	36.9	24.3 B	14.7 B	20
21	22.0 B	23.9 B	32.1 B	1100	1450	149	34.0	25.9	24.2	36.0	24.0 B	14.6 B	21
22	21.6 B	24.4 B	32.6 B	1130	1350	144	33.3	24.3	20.4	35.8	23.4 B	14.7 B	22
23	21.5 B	25.1 B	33.2 B	1250	1250	134	31.3	21.6	24.9	36.1	22.2 B	15.2 B	23
24	21.6 B	26.4 B	34.5 B	1290	1140	126	29.2	19.5	25.3	35.7	21.3 B	15.5 B	24
25	21.4 B	27.7 B	35.5 B	1150	1010	120	29.5	18.1	25.4	34.6	20.7 B	15.6 B	25
26	21.6 B	28.4 B	37.6 B	985	907	112	29.1	16.6	25.4	35.1	20.0 B	15.8 B	26
27	22.0 B	28.6 B	38.5 B	871	873	111	29.1	15.8	25.4	44.4	19.6 B	16.4 B	27
28	22.5 B	28.4 B	39.9 B	712	820	110	31.0	19.4	25.8	35.1	19.1 B	16.7 B	28
29	22.6 B		43.7 B	617	753	130	37.7	18.7	26.9	30.8	18.3 B	16.4 B	29
30	23.0 B		50.0 B	578	684	166	39.3	18.0	27.6	36.7	17.4 B	16.3 B	30
31	23.2 B		55.6 B		633		102	17.4		34.6		16.2 B	31
TOTAL	1656.9	663.5	954.6	20667.3	30881	7770	3255.8	1702.5	881.0	1030.4	787.9	486.4	TOTA
MEAN	53.4	23.7	30.8	689	996	259	105	54.9	29.4	33.2	26.3	15.7	MEAN
AC FT	3290	1320	1890	41000	61300	15400	6460	3380	1750	2040	1560	965	AC F
MAX	133	28.6	55.6	1290	2510	585	325	174	40.7	44.4	33.7	16.9	MAX
MIN	21.4	19.7	22.7	60.8	595	110	29.1	15.8	16.7	25.8	17.4	14.6	MIN

SUMMARY FOR THE YEAR 1970

MEAN DISCHARGE, 194 CFS
TOTAL DISCHARGE, 140000 AC-FT
MAXIMUM DAILY DISCHARGE, 2510 CFS ON MAY 18
MINIMUM DAILY DISCHARGE, 14.6 CFS ON DEC 21

MAXIMUM INSTANTANEOUS DISCHARGE
2580 CFS AT 1450 PST ON MAY 18

TYPE OF GAUGE - RECORDING
LOCATION - LAT 55 57 25 N
LONG 120 33 45 W
DRAINAGE AREA 1270 SQ MILES

B-ICE CONDITIONS

NATURAL FLOW

Figure 4.3-1. Sample page from "Surface Water Data."

Station No.	Name	Drainage Area (Sq. Mi.)	Latitude-Longitude	Discharge Records (Daily Only ?) (Misc. Meas. #)	Type of Gauge	Operation	Adj. Incl. Tape	Note
	Assiniboine River Basin:							
[illegible]	. . . Assiniboine River near Holland	[illegible]	49° 41' 54" 98° 53' 56"	54-60* [illegible]	M M R	S [illegible] C	Yes	1
05MJ005	. . . Assiniboine River near Rossendale	61,400	49° 45' 32" 98° 38' 32" W21-09-09-W1	70-71	M	C	No	1
05MJ006	. . . Portage Reservoir near Portage La Prairie		49° 56' 10" 98° 20' 10" SE22-11-07-W1	70-71*	R	S	No	5
05MJ003	. . . Assiniboine River near Portage La Prairie	[illegible]	49° 56' 09" 98° 16' 48" SW19-11-06-W1	22*,31*,23-30 52-60 61-71	M M R	S C C	Yes	1,2,6
05MJ001	. . . Assiniboine River at Headingley	[illegible]	49° 52' 09" 97° 24' 10"	13-52 53-59,60,61-71	M R	C C	Yes	1,6
05MJ002	. . . Assiniboine River at St. James		49° 52' 30" 97° 11' 30"	12-13 34#, 37#	M	S -	Yes	
05MD007	. . . . Shell River near Roblin	[illegible]	51° 21' 39" 101° 15' 21" SW06-28-27-W1	62-71	M	C	Yes	
05MD002	. . . . Shell River Four Miles South of Roblin	[illegible]	51° 10' 10" 101° 19' 40"	19-20#, 33-35# 22-27 28-32	- M M	- C S	Yes	
05MD001	. . . . Shell River at Asessippi		50° 56' 50" 101° 19' 00"	13#, 24# 14-19 [illegible]	- M M	- C S	Yes	
05MD005	. . . . Shell River near Inglis	[illegible]	50° 57' 40" 101° 19' 05" NW03-23-28-W1	48-55 56-61 62-71	M M R	S C C	Yes	
	. . . . . East Shell River:							
05MD008	. . . . . Childs Lake near Boggy Creek		51° 34' 37" 101° 01' 54"	44-71*	M	S	Yes	
05MD005	. . . . Conjuring Creek near Russell	33.0	50° 47' 30" 101° 17' 55" NE09-21-28-W1	59-71	M	S	Yes	
05MD016	. . . . Qu'Appelle River near St. Lazare	22,000	50° 26' 25" 101° 19' 35"	67-71	M	C	Yes	2,4
05MD003	. . . . Birdtail Creek near Birtle	[illegible]	50° 31' 50" 100° 57' 00"	53-71	M	S	Yes	
05MD002	. . . . Birdtail Creek at Birtle	[illegible]	50° 25' 15" 101° 02' 40"	14-17 24-26, 28 [illegible]	M M M	C S S	Yes	3

M - Manual gauge
R - Recording gauge
C - Continuous operation
S - Seasonal operation

1 - Sediment data available.
2 - Water quality data available.
3 - Miscellaneous measurements were obtained in 1918 and 1921.
4 - Data not published.
5 - Telemetering device installed.
6 - Data to 1960 have been reviewed.

Figure 4.3-2. Sample page from "Surface Water Data Reference Index."

BIG OTTER CREEK NEAR VIENNA - STATION NO. 02GC004

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGE IN AC-FT

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	YEAR	TOTAL DISCHARGE
1948	---	---	---	1948	---
1949	---	3730 CFS ON FEB 16	41.0 CFS ON NOV 10	1949	170000 AC-FT
1950	---	4120 CFS ON APR 5	43.0 CFS ON OCT 6	1950	282000 AC-FT
1951	---	3400 CFS ON FEB 22	36.0 CFS ON SEP 10	1951	258000 AC-FT
1952	---	3040 CFS ON MAR 11	36.0 CFS ON AUG 7	1952	180000 AC-FT
1953	---	1700 CFS ON MAR 4	51.0 CFS ON OCT 5	1953	113000 AC-FT
1954	---	---	---	1954	---
1955	---	2530 CFS ON MAR 1	39.0 CFS ON JUL 15	1955	186000 AC-FT
1956	---	2520 CFS ON MAR 3	80.0 CFS ON AUG 1	1956	223000 AC-FT
1957	---	2070 CFS ON APR 6	92.0 CFS ON AUG 19	1957	216000 AC-FT
1958	---	565 CFS ON APR 10	49.0 CFS ON SEP 3	1958	120000 AC-FT
1959	---	1230 CFS ON APR 4	57.0 CFS ON JUL 16	1959	209000 AC-FT
1960	---	2710 CFS ON MAR 30	51.0 CFS ON SEP 29	1960	198000 AC-FT
1961	---	1790 CFS ON APR 26	47.0 CFS ON FEB 1	1961	168000 AC-FT
1962	---	---	---	1962	---
1963	---	---	---	1963	---
1964	995 CFS AT 0300 EST ON AUG 24	839 CFS ON AUG 24	25.0 CFS ON AUG 1	1964	118000 AC-FT
1965	7410 CFS AT 0500 EST ON MAR 7	6400 CFS ON MAR 6	39.6 CFS ON JUL 30	1965	236000 AC-FT
1966	2080 CFS AT 1030 EST ON DEC 8	2040 CFS ON DEC 8	41.4 CFS ON JUL 22	1966	177000 AC-FT
1967	1850 CFS AT 0300 EST ON DEC 22	1800 CFS ON DEC 22	57.0 CFS ON SEP 11	1967	197000 AC-FT
1968	5340 CFS AT 2330 EST ON FEB 3	3700 CFS ON FEB 3	64.0 CFS ON JUL 28	1968	206000 AC-FT
1969	6180 CFS AT 2100 EST ON JAN 30	5110 CFS ON JAN 31	73.3 CFS ON SEP 14	1969	248000 AC-FT
1970	1480 CFS AT 1556 EST ON APR 3	1420 CFS ON APR 3	44.1 CFS ON AUG 10	1970	144000 AC-FT
				MEAN	192000 AC-FT

EXTREMES OF DISCHARGE FOR THE PERIOD OF RECORD

MAX. INST. DISCHARGE IS 7410 CFS ON MAR 7 1965 AT 0500 EST
MAX. DAILY DISCHARGE IS 6400 CFS ON MAR 6 1965
MIN. DAILY DISCHARGE IS 25.0 CFS ON AUG 1 1964

BIGHEAD RIVER NEAR MEAFORD - STATION NO. 02FB010

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1957	---	---	---	---	88.5	69.9	63.6	23.5	122	132	218	318	---
1958	135	107	178	264	63.2	39.1	23.8	19.2	18.5	22.7	36.9	53.7	79.8
1959	76.4	72.9	251	655	192	60.5	32.6	28.3	28.9	47.1	208	213	155
1960	188	136	165	626	417	108	41.4	29.4	26.4	31.7	74.6	59.5	158
1961	69.5	204	399	340	165	114	47.2	43.8	42.6	30.6	119	250	152
1962	107	129	334	365	95.0	29.4	21.3	14.9	18.5	34.0	70.6	147	114
1963	55.0	45.4	430	251	285	66.8	30.2	29.8	21.6	24.0	83.2	54.5	115
1964	196	116	279	198	78.1	30.4	23.1	18.5	14.8	20.9	21.5	101	91.6
1965	121	249	113	697	198	51.2	31.2	23.9	22.2	45.6	89.5	292	160
1966	163	275	304	154	77.1	39.9	17.6	17.9	14.1	18.2	42.9	195	109
1967	185	116	258	450	109	118	123	64.5	54.6	142	367	324	193
1968	148	358	453	264	134	63.2	30.4	93.5	57.2	69.1	201	298	180
1969	234	200	293	574	318	137	62.6	37.5	37.5	66.0	121	106	182
1970	84.4	96.3	150	644	149	52.2	65.0	29.0	61.0	99.2	121	168	143
MEAN	136	162	277	422	169	70.0	43.8	33.8	38.6	55.9	127	184	141

BIGHEAD RIVER NEAR MEAFORD - STATION NO. 02FB010

ANNUAL EXTREMES OF DISCHARGE IN CFS AND ANNUAL TOTAL DISCHARGE IN AC-FT

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE	MAXIMUM DAILY DISCHARGE	MINIMUM DAILY DISCHARGE	YEAR	TOTAL DISCHARGE
1957	---	---	---	1957	---
1958	---	605 CFS ON APR 1	11.0 CFS ON SEP 15	1958	57800 AC-FT
1959	---	1390 CFS ON APR 3	14.0 CFS ON SEP 8	1959	113000 AC-FT
1960	---	2550 CFS ON APR 3	16.5 CFS ON OCT 17	1960	115000 AC-FT
1961	---	1280 CFS ON MAR 28	18.0 CFS ON AUG 21	1961	110000 AC-FT
1962	---	1750 CFS ON MAR 30	6.5 CFS ON AUG 20	1962	82200 AC-FT
1963	---	3100 CFS ON MAR 26	13.2 CFS ON SEP 9	1963	83500 AC-FT
1964	---	1010 CFS ON MAR 5	10.3 CFS ON SEP 14	1964	66500 AC-FT
1965	---	1800 CFS ON APR 12	12.6 CFS ON AUG 23	1965	116000 AC-FT
1966	---	2100 CFS ON FEB 11	4.6 CFS ON SEP 19	1966	79000 AC-FT
1967	2260 CFS AT 0700 EST ON APR 1	1980 CFS ON APR 1	20.5 CFS ON SEP 17	1967	139000 AC-FT
1968	2770 CFS AT 1745 EST ON FEB 2	2230 CFS ON FEB 2	15.2 CFS ON AUG 12	1968	131000 AC-FT
1969	1550 CFS AT 0937 EST ON APR 5	1400 CFS ON APR 5	15.2 CFS ON SEP 1	1969	132000 AC-FT
1970	1800 CFS AT 1903 EST ON APR 9	1650 CFS ON APR 9	19.2 CFS ON AUG 15	1970	103000 AC-FT
				MEAN	102000 AC-FT

EXTREMES OF DISCHARGE FOR THE PERIOD OF RECORD

MAX. INST. DISCHARGE IS 2770 CFS ON FEB 2 1968 AT 1745 EST
MAX. DAILY DISCHARGE IS 3100 CFS ON MAR 26 1963
MIN. DAILY DISCHARGE IS 4.6 CFS ON SEP 19 1966

BLACK CREEK AT SCARLETT ROAD - STATION NO. 02HC027

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC FEET PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1966	---	---	---	---	---	---	---	8.1	10.8	9.6	18.4	26.7	---
1967	13.9	12.0	37.6	36.4	17.1	43.3	23.7	14.2	20.8	20.5	20.0	31.1	24.3
1968	17.6	46.9	57.5	18.7	22.9	16.6	12.1	33.7	17.1	14.1	32.7	21.4	25.9
1969	43.6	14.8	27.8	41.0	29.2	14.4	21.5	17.4	10.7	18.7	27.9	15.7	23.6
1970	10.4	17.4	68.2	41.6	23.4	14.3	22.1	27.7	20.7	17.6	22.5	21.9	25.7
MEAN	21.4	22.8	47.8	34.4	23.2	22.2	19.9	20.2	16.0	16.1	24.3	23.4	24.9

Figure 4.3-3. Sample page from "Historical Streamflow Summary."

Environment Canada, Ottawa K1A 0E7, Ontario (Telephone 819-997-2098), or from the District Engineers at Vancouver, Calgary, Regina, Winnipeg, Guelph and Halifax, or the Area Engineer at Montreal (see "Addresses").

Details of individual stations and related records, as well as recent data that have not yet been published, may be obtained on application to the District Engineers or to the Director, Water Resources Branch.

Streamflow data can also be supplied in card format either on punched cards or magnetic tape. Although there is no charge for the data at present, the user is asked to supply his own tape. These data are available on application to the Director, Water Resources Branch.

4.4 Users

Data publications are sent to some 588 names on a mailing list which includes addresses in 18 foreign countries and, in Canada, to engineering consultants, universities (libraries, professors and students), provincial agencies (water resources, power, highways and fisheries), federal departments, municipal agencies (waterworks), power companies, technological institutes, railways, and individuals such as high school students.

Daily discharge data have also been supplied to a similar variety of users, in the form of magnetic tape, computer printouts or punched cards.

4.5 Plans

No change is proposed in the three types of data publications in the immediate future.

Within the next two or three years, daily water levels and maximum instantaneous discharges and water levels are expected to be made available to users on magnetic tape, as the daily discharge data are at present.

A minicomputer has been interfaced with the digitizer (pencil follower) to investigate the possibility of improving computation procedures. This system will be recommended for the district offices if it proves feasible over the next two or three years.

In 1973, it is planned to produce coloured maps, showing the locations of active and discontinued streamflow and water level stations, similar to those included in the 1968 Surface Water Data Reference Indexes.

5.0 Groundwater (GOWN System)

5.1 Groundwater Observation Well Network (GOWN)

The development of an automated groundwater data storage and retrieval system in the Inland Waters Directorate began in 1965. It was intended initially to store data for a groundwater observation well network, but GOWN has since expanded into a general purpose data processing system for the large volume of data available in the field of hydrogeology.

The data come from many sources, such as provincial water well drillers' reports and drilling programs for federal research projects. Data on fluid potentials are usually collected with analog or digital recorders. Floats or Keck sensors are normally used as the water level sensing devices.

5.2 Procedures

GOWN is an open-ended system that allows new files to be created and new types of data to be added to the existing magnetic tape files with a minimum of programming changes. It permits a wide variety of hydrogeologic data to be stored, and therefore is flexible and does not become rapidly obsolete (1).

At present, three files are in operation:

- Well Data,
- Well Log,
- Catalogue

In addition, a Hydrograph file is 60 per cent completed.

The Well Data file stores various information on well construction and instrumentation, and on the hydrogeologic characteristics of any aquifers penetrated by the well.

The Well Log file stores the lithologic log from a well or test hole, with the description of the formation coded mnemonically in five four-character fields (2). Additional parameter coded information, such as ground elevation and total depth, is also included in order to use the Well Log file more efficiently.

The accompanying Well Data and Well Log file coding sheets (Figures 5.2-1 and 5.2-2) show the types of data stored on each of these files.

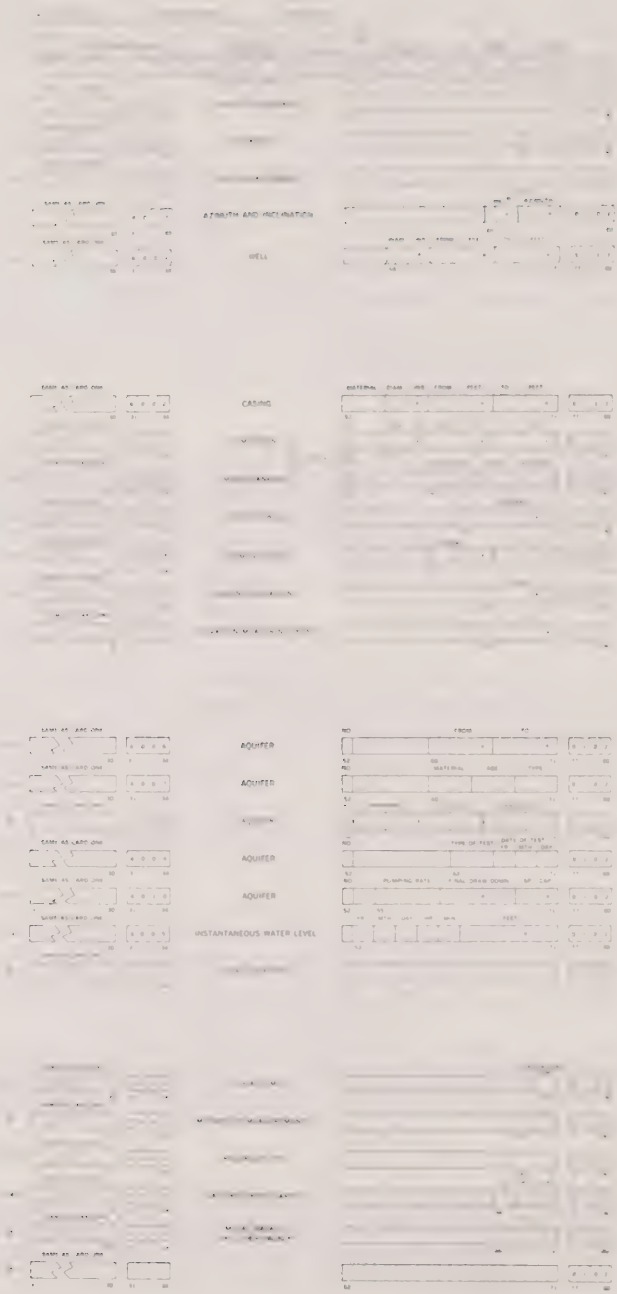


Figure 5.2-1. Well data coding sheets.

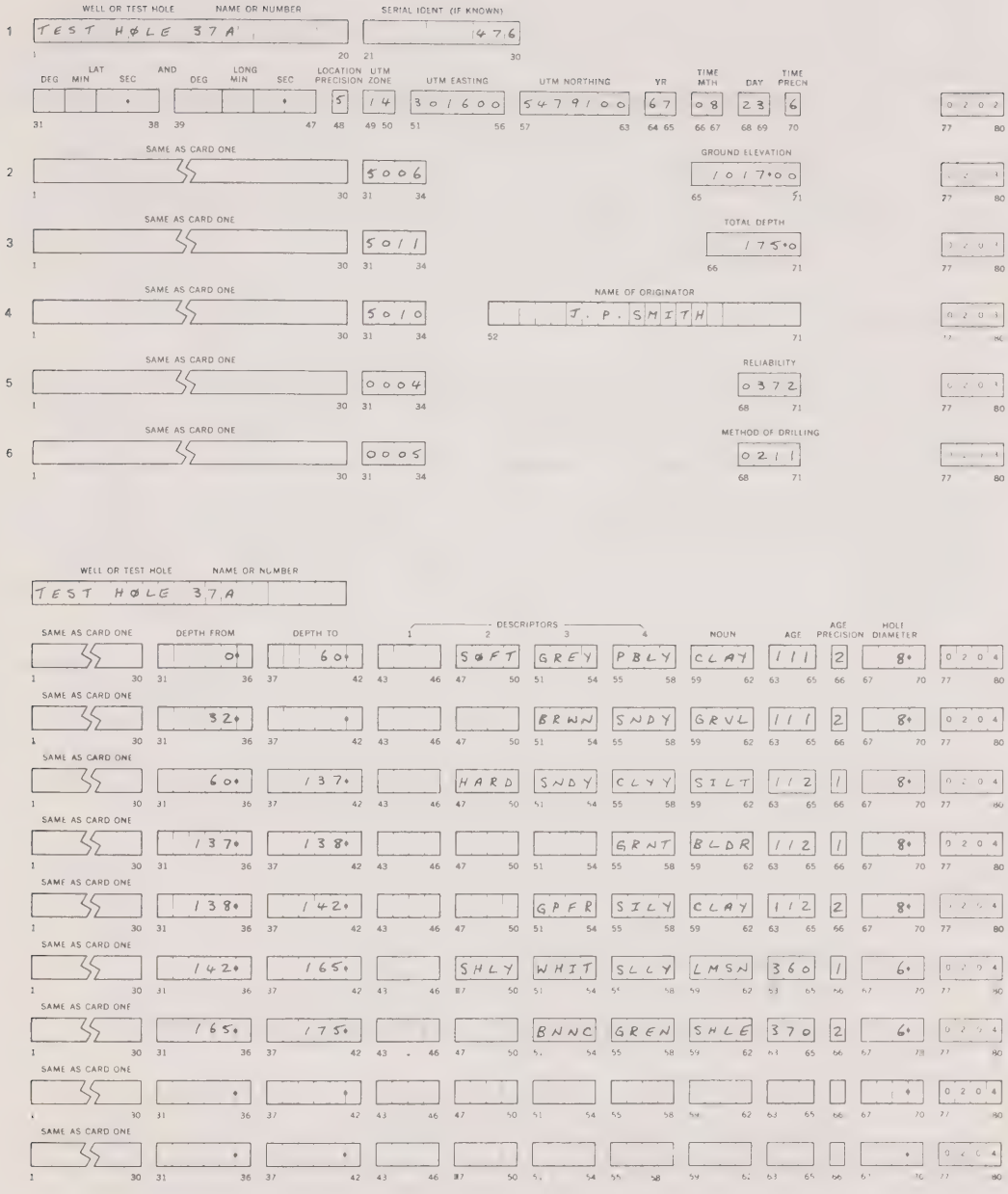


Figure 5.2-2. Well log coding sheets.

The Catalogue file contains no data, but it lists all of the types of data stored in GOWN by location, time and serial number. This file is automatically updated whenever data are changed or are added to the system. The accompanying sample page (Figure 5.2-3) shows the format in which GOWN data are catalogued.

The Well Hydrograph file will store information on groundwater levels obtained from analog or digital recorders. Analog records can be converted to digital form by using a chart digitizer. A series of manually obtained measurements can be stored by a simple card-to-tape conversion program.

5.3 Availability

In terms of volume, the most important sources of data are the provincial water well drillers' annual records maintained by various provincial agencies. Examples of these are the data for 60,000 wells in the Lake Ontario Drainage Basin provided through a co-operative project with the Ontario Water Resources Commission in connection with the International Field Year for the Great Lakes. Another 10,000 wells have been coded in the GOWN format through a joint program with the Manitoba Water Control and Conservation Branch. Data for about 5,000 wells held by the Inland Waters Directorate will also be coded and stored in the system, but are available at present only in a manual format.

The Catalogue file is a list of references to the data stored in GOWN. A formal publication of the data has not been considered, since the collection of water well drillers' records has been the responsibility of provincial agencies, who have already published these data in water well reports.

Any data stored in GOWN are available to agencies interested in hydrogeologic data, but permission for release and use of the data must be obtained first from the provincial or federal agency that collected the data. These data, or any portion of them, are available on magnetic tape in the format of the GOWN master files. Programs and documentation are also available to those who may want to establish their own data processing systems.

Requests for information should be sent to the GOWN Program Co-ordinator, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario (Telephone 819-997-2466).

The general purpose retrieval program is designed to extract from the GOWN master files those wells that conform to criteria specified by the user. At present, these retrievals may be made from the Well Data and Well Log files, but other files may be added later. The criteria are converted by a program using a "dictionary" to a form acceptable to a "macro decoder" program, which generates a series of Cobol program instructions, which in turn produce the output for retrieval.

HOLE SERIAL NO	FIL TYP	LATITUDE DEG MIN SEC	LONGITUDE DEG MIN SEC	PR CD	TIME-FROM YR MO DY HR MI	TIME-TO YR MO DY HR MI	PR CD	RECORD SEQ	REEL NO	TEST-HOLE NUMBER
6726	1	43 50 4542	80 45 3895	5	1963 12 01 12 00		6			LODB 6701667
6726	2	43 50 4542	80 45 3895	5	1963 12 02 00 00		6	000001	000001	LODB 6701667
6727	1	43 50 3109	80 50 3940	9	1957 08 12 12 00		6			LODB 6701668
6727	2	43 50 3109	80 50 3940	9	1957 08 13 00 00		6	000001	000001	LODB 6701668
6728	1	43 50 0884	80 52 1092	9	1958 09 29 12 00		6			LODB 6701669
6728	2	43 50 0884	80 52 1092	9	1958 09 30 00 00		6	000001	000001	LODB 6701669
6729	1	43 49 5682	80 52 0915	9	1950 06 26 12 00		6			LODB 6701670
6729	2	43 49 5682	80 52 0915	9	1950 06 27 00 00		6	000001	000001	LODB 6701670
6730	1	43 49 5844	80 52 0962	9	1953 12 13 12 00		6			LODB 6701671
6730	2	43 49 5844	80 52 0962	9	1953 12 14 00 00		6	000001	000001	LODB 6701671
6731	1	43 49 4573	80 53 4290	5	1961 03 01 12 00		6			LODB 6701672
6731	2	43 49 4573	80 53 4290	5	1961 03 02 00 00		6	000001	000001	LODB 6701672
6732	1	43 51 2221	80 49 1135	9	1952 11 13 12 00		6			LODB 6701673
6732	2	43 51 2221	80 49 1135	9	1952 11 14 00 00		6	000001	000001	LODB 6701673
6733	1	43 51 0550	80 51 1922	9	1954 05 25 12 00		6			LODB 6701674
6733	2	43 51 0550	80 51 1922	9	1954 05 26 00 00		6	000001	000001	LODB 6701674
6734	1	43 50 2630	80 56 3055	5	1960 04 18 12 00		6			LODB 6701675
6734	2	43 50 2630	80 56 3055	5	1960 04 19 00 00		6	000001	000001	LODB 6701675
6735	1	43 50 2824	80 56 4844	9	1957 04 28 12 00		6			LODB 6701676
6735	2	43 50 2824	80 56 4844	9	1957 04 29 00 00		6	000001	000001	LODB 6701676
6736	1	43 52 0354	80 44 5618	9	1959 02 02 12 00		6			LODB 6701678
6736	2	43 52 0354	80 44 5618	9	1959 02 03 00 00		6	000001	000001	LODB 6701678
6737	1	43 51 2995	80 48 5407	5	1960 02 07 12 00		6			LODB 6701679
6737	2	43 51 2995	80 48 5407	5	1960 02 08 00 00		6	000001	000001	LODB 6701679
6738	1	43 51 2192	80 49 4767	5	1962 10 30 12 00		6			LODB 6701680
6738	2	43 51 2192	80 49 4767	5	1962 10 31 00 00		6	000001	000001	LODB 6701680
6739	1	43 52 4803	80 46 2683	9	1959 01 05 12 00		6			LODB 6701681
6739	2	43 52 4803	80 46 2683	9	1959 01 06 00 00		6	000001	000001	LODB 6701681
6740	1	43 53 0751	80 45 1425	9	1951 10 29 12 00		6			LODB 6701682
6740	2	43 53 0751	80 45 1425	9	1951 10 30 00 00		6	000001	000001	LODB 6701682
6741	1	43 52 5422	80 46 3846	5	1962 05 29 12 00		6			LODB 6701683
6741	2	43 52 5422	80 46 3846	5	1962 05 30 00 00		6	000001	000001	LODB 6701683
6742	1	43 52 1203	80 52 4382	9	1951 01 18 12 00		6			LODB 6701684
6742	2	43 52 1203	80 52 4382	9	1951 01 19 00 00		6	000001	000001	LODB 6701684
6743	1	43 53 4052	80 48 2534	5	1960 11 14 12 00		6			LODB 6701685
6743	2	43 53 4052	80 48 2534	5	1960 11 15 00 00		6	000001	000001	LODB 6701685
6744	1	43 53 1780	80 51 2289	5	1963 07 19 12 00		6			LODB 6701686
6744	2	43 53 1780	80 51 2289	5	1963 07 20 00 00		5	000001	000001	LODB 6701686
6745	1	43 53 5848	80 46 4785	9	1954 08 17 12 00		6			LODB 6701687
6745	2	43 53 5848	80 46 4785	9	1954 08 18 00 00		6	000001	000001	LODB 6701687
6746	1	43 53 4297	80 51 3513	5	1958 10 28 12 00		6			LODB 6701688
6746	2	43 53 4297	80 51 3513	5	1958 10 29 00 00		6	000001	000001	LODB 6701688
6747	1	43 53 2169	80 53 0520	9	1957 04 17 12 00		6			LODB 6701689
6747	2	43 53 2169	80 53 0520	9	1957 04 18 00 00		6	000001	000001	LODB 6701689
6748	1	43 53 1068	80 53 3843	9	1962 08 08 12 00		6			LODB 6701690
6748	2	43 53 1068	80 53 3843	9	1962 08 09 00 00		6	000001	000001	LODB 6701690
6749	1	43 53 0524	80 54 2487	5	1965 10 14 12 00		6			LODB 6701691
6749	2	43 53 0524	80 54 2487	5	1965 10 15 00 00		6	000001	000001	LODB 6701691
6750	1	43 53 0232	80 55 0843	9	1951 11 12 12 00		6			LODB 6701692
6750	2	43 53 0232	80 55 0843	9	1951 11 13 00 00		6	000001	000001	LODB 6701692

Figure 5.2-3. Catalogue file.

At this point, data for the retrieval wells may be listed or can be passed to a secondary retrieval phase. Depending on the type of map or the mathematical or statistical routine for which the wells have been retrieved, the secondary retrieval selects one item or more of data from the Well Log or Well Data records, and passes the data to a processing routine. For example, in producing a contour map, the processing routine determines the x, y and z co-ordinates for each well.

The nine basic types of maps that can be retrieved include the following:

(i) Surface Elevation of a Specific Material: Elevation, in feet above sea level, of the surface of the first occurrence of the specified material will be contoured. The Well Log file contains, for each stratum, the mnemonic noun (i.e., the material) and the age of the material. The material will be considered found if i) the age > some constant K, or ii) the mnemonic noun is found.

(ii) Isopach (thickness) of Materials above a Specified Material: Thickness, in feet, will be contoured. The "depth from field" of the first occurrence of the specified material will give the thickness of the materials. The specified material will be determined as outlined in i).

(iii) Total Thickness of Specified Materials above a Specified Material: Thickness, in feet, will be contoured. Thickness of all strata having one of the specified material(s) above the first occurrence of a specified material will be accumulated to obtain total thickness. The first occurrence will be determined as in i).

(iv) Water Table Depth: Depth of water will be contoured for wells with depths less than some arbitrary constant K. The depth of the well is taken from ground level; instantaneous water level is the distance in feet to the top of the water from the measuring point.

(v) Water Table Elevation: Elevation, in feet from sea level, of the top of the water for wells that satisfy iv will be contoured.

(vi) Piezometric Surface Elevation at Given Elevation: Elevation in feet above sea level, of the top of the water will be contoured for wells that satisfy these criteria - a) total depth - depth to water > K, and b) A ≤ ground elevation - total depth < B.

(vii) Specific Capacity of Bedrock Wells: Specific capacity will be contoured. If a well has more than one aquifer, the aquifer with the highest specific capacity will be chosen.

(viii) Specific Capacity of Overburden Wells: Specific capacity of all overburden wells will be contoured. If a well has more than one aquifer, the aquifer with the highest specific capacity will be chosen.

(ix) Thickness of a Particular Material: Stratum thickness, in feet, of the first occurrence of a specified material will be contoured; the first occurrence will be determined as in i).

5.4 Users

The system is being used currently to produce Lake Ontario Drainage Basin maps, which will be compared with maps produced manually for the same region by the Ontario Ministry of the Environment. This will provide an evaluation of the capability of an automated system to produce maps on a routine basis, and it should be of interest to potential users of the system's techniques in provincial agencies and universities.

The Alberta Department of the Environment has been testing the programs of the GOWN system and is planning to use the data editing and storage program to set up files in its own computer system.

5.5 Plans

It is expected that emphasis will be placed on the development of a wider variety of retrieval procedures, including those for tabular listings and automated production of trend surface maps, residual surface maps, fence diagrams, three-dimensional diagrams, etc.

5.6 References

1. Gilliland, J.A., and A. Treichel, *GOWN - A computer storage system for groundwater data*. Canadian Journal of Earth Sciences, Vol. 5, No. 6, 7 pp.

2. Gilliland, J.A., and G. Grove, *Groundwater Data System Manual*, 4th Edition. Inland Waters Directorate, Environment Canada.

6.0 Glaciology (Glaciology System)

6.1 Glacier Investigation and Glacier Inventory

Both the Glaciology Division and the Applied Hydrology Division of the Inland Waters Directorate carry out studies on glaciers in Canada. Data are collected and presented in slightly different formats, so the work of these Divisions is discussed separately.

First of all, the Glaciology Division and its predecessors have been collecting and publishing data on the mass, energy and water balance of selected glaciers as part of the Canadian contribution to the International Hydrological Decade (IHD) starting in 1965. More general information on Canadian glaciers is provided by the Glacier Inventory. Results from these works are given in scientific journals and publications listed in "Research Projects in Glaciology" (1).

Secondly, in Western Canada, the Applied Hydrology Division, the Water Survey of Canada and its predecessors have surveyed a small sample of glaciers since 1945 to determine toe recession, volumetric change and glacier contribution to streamflow. Data summaries have not been automated, but results are published regularly in reports of the Division (2).

6.2 Procedures

In the Glaciology Division, information is available on Western Canada and the Arctic areas as follows:

(i) Data obtained from aerial photographs and maps are compiled according to a region and basin coding system. The glacier inventory is concerned with the physical characteristics of glaciers and descriptions of each glacier's primary classification, form, frontal characteristics, longitudinal profile, nourishment and activity (3). For each glacier in the inventory, there are completed data sheets (see Figure 6.2-1) and index maps at a scale of 1:500,000.

(ii) Mass, water and energy balance value for selected glaciers (see Figure 6.2-2). This involves field studies from May to early October on six glaciers in Western Canada, and June to late August on two glaciers in the Arctic. These studies include measurement of winter accumulation and summer melt, together with records of meteorological conditions and glacier stream discharge (4).

Province or Territory: _____

Mountain Area: _____

Hydrological Basin:

1st Order: _____

2nd Order: _____

3rd Order: _____

4th Order: _____

Sources: Maps _____

Map Title and Number: _____

Compiled By: _____

Date: _____

Scale: _____

Contour Interval: _____

Reliability:

Vertical: _____

Horizontal: _____

Sources: Photographs

Type: _____

Serial Number: _____

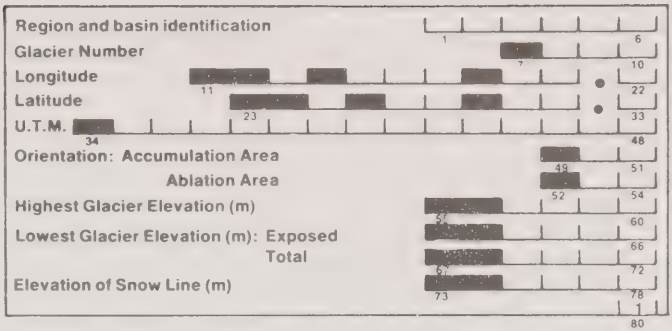
Date: _____

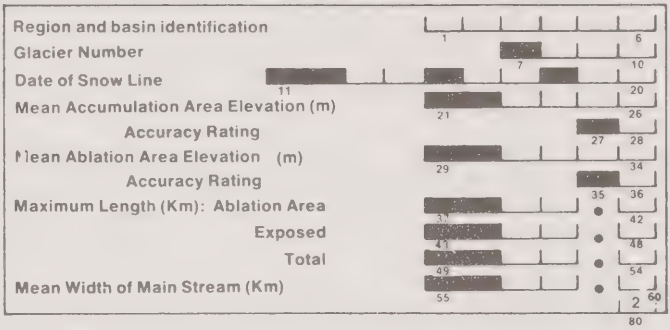
Flying Height: _____

Focal Length: _____

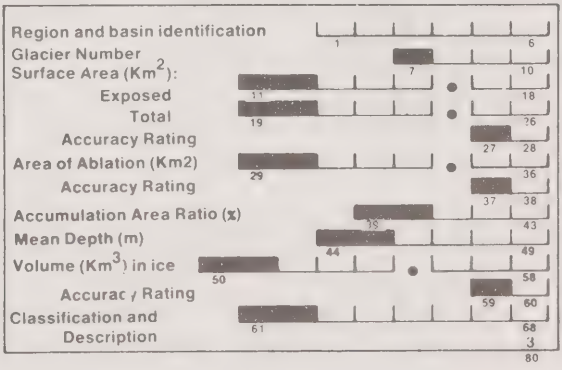
Remarks: _____

_____

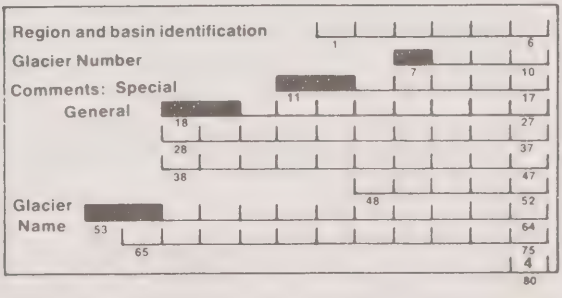




Work Done on Glacier:	References
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	



	Other Photos	Special	Moraine	Lake
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				



Remarks _____

_____

_____

_____

Data Compiled by: _____

Date: _____

Supervisor: _____

Centre: _____

Figure 6.2-1 Data Sheet for Canadian Glacier Inventory.

Glacier	Latitude	Longitude	Period of Study	Mass Balance	Meteorology	Surveying	Runoff	Maps
Peyto	51°40'N	116°34'W	1966-	x	x	x	x	1: 10, 000
Ram	51°51'N	116°12'W	1966-	x	x	x	x	1: 10, 000
Woolsey	50°00'N	118°13'W	1966-	x	x	x	x	1: 10, 000
Sentinel	49°50'N	122°55'W	1966-	x	x	x	x	1: 10, 000
Place	50°18'N	122°48'W	1966-	x	x	x	x	1: 10, 000
Berendon	56°15'N	130°10'W	1968-	x	x	x	x	1: 10, 000
Decade	69°38'N	69°48'W	1966-	x	x	x	x	1: 10, 000
Per Ardua	81°32'N	76°35'W	1965-	x	x	x	x	1: 10, 000
Barnes Ice Cap	70°N	73°W	1962-71	x		p		1: 50, 000

Figure 6.2-2 Nature and Length of Glaciology Division Glacier Investigations

Records are reduced to daily averages and mass balance is determined as changes within elevation zones.

The Water Survey and Applied Hydrology Divisions carry out biennial surveys on a sample of glaciers in Canada (see Figure 6.2-3). The former make use of transit stadia survey methods to determine glacier profiles for calculating volumetric changes. Water discharge is measured by current meter or is estimated. The Applied Hydrology Division uses terrestrial photogrammetry and a Wild A-7 autograph (plotter) to produce large-scale maps of the lower areas (up to the snowline) of seven glaciers in Western Canada. From these maps, the linear, areal and volumetric changes can be calculated for the period between surveys (two-year period).

6.3 Availability

Data from the inventory and IHD glacierized basin studies may be obtained from the Glaciology Division, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario. (Telephone 819-997-2476).

The inventory file is available as printouts of data, summary tabulations and index maps (see Figure 6.3-1). Maps for areas now completed are available from the Canada Map Office or the Division. Summary reports of Peyto and Victoria glaciers in Alberta have been prepared from information available from the Water Survey of Canada. Information about the combined balance studies of Berendon, Sentinel, Place and Woolsey glaciers in British Columbia, Peyto and Ram River in Alberta, and Per Ardua and Decade in the Northwest Territories can be provided in printouts of meteorological data, together with page-size maps, charts and graphs.

The results of surveys made by the Water Survey of Canada are presented in reports from District Offices, and are available in limited numbers from the District Engineer concerned in Vancouver or Calgary (see "Addresses"). However, the work on each glacier is being prepared for wider distribution in Glacier Inventory Notes. To date, the Peyto and Victoria Surveys have been published (2). Reports on the work performed by the Special Services Section of the Applied Hydrology Division appear in the Directorate's report series (2), which may be obtained from the Publications Section, Inland Waters Directorate, Environment Canada, Ottawa K1A 0E7, Ontario. These sets of data are not stored in computer banks.

The surveys include the following glaciers (those underlined have been discontinued):

British Columbia - Bugaboo, Franklin, Helm, Illecillewaet, Kokanee, Nadahini, Sphinx and Sentinel.

Alberta - Angel, Athabasca, Freshfield, Lyell, Peyto, Saskatchewan and Victoria.

GLACIERS	Lat.	Long.	No. of Times Surveyed	Period	Office	DATA IN REPORTS (GENERALLY) Maps	Volumetric Change	Recession of Toe	Advance of Plaque Line	Discharge Ice	Discharge Water	Photograph Record
ANGEL	52°-41'	118°-04'	2	1946-47	CALGARY							×
ATHABASCA	52°-12'	117°-14'	15	1946-70	CALGARY			×	×		×	×
ATHABASCA	52°-12'	117°-14'	5	1959-69	HEAD	×	×			×		×
FRESHFIELD	51°-47'	116°-53'	6	1947-54	CALGARY			×	×			×
LYELL	51°-57'	117°-03'	1	1947	CALGARY							×
PEYTO	51°-41'	116°-32'	12	1945-62	CALGARY			×	×			×
SASKATCHEWAN	52°-08'	117°-12'	15	1946-70	CALGARY							×
SASKATCHEWAN	52°-08'	117°-12'	4	1963-69	HEAD	×	×	×				×
VICTORIA	51°-23'	116°-16-5	8	1945-54	CALGARY			×	×		e	×
BUGABOO	50°-40'	116°-45'	4	1964-70	HEAD	×	×					×
FRANKLIN	51°-15'	125°-25'	4	1945-48	VANCOUVER			×				×
East Tongue			10	1945-48	VANCOUVER			×	×		e	×
HELM												
West Tongue	49°-57'	123°-00'	12	1945-62	VANCOUVER			×			e	×
ILLECILLEWAET	51°-14'	117°-25'	12	1945-62	VANCOUVER			×	×		e	×
Joker Creek												
Tongue	49°-45'	117°-08'	12	1945-62	VANCOUVER			×	×		e	×
KOKANEE												
Coffee Creek												
Tongue			10	1945-58	VANCOUVER			×	×		e	×
Coffee Creek												
Tongue	49°-45'	117°-08'	4	1964-70	HEAD	×	×					×
KOKANEE												
NADAHINI	59°-44'	136°-41'	4	1964-70	HEAD	×	×					×
SPHINX	49°-53'	123°-06'	4	1964-70	HEAD	×	×	×				×
SPHINX	49°-53'	123°-06'	12	1945-62	VANCOUVER			×	×		e	×
SENTINEL	49°-53'	122°-58'	4	1964-70	HEAD	×	×				e	×
SENTINEL	49°-53'	122°-58'	12	1945-62	VANCOUVER			×	×		e	×

Figure 6.2-3 Glaciers Surveyed by the Applied Hydrology Division and Water Survey of Canada

Water Survey Basin Number	Name	Number of Glaciers	Map Number	Coordinates	Orientation	Snow Line	Date	Length Width Area		AAR	Depth	Volume	Classification
10TA	Victoria Island												
10TB	Banks Island												
10TC	Islands North of Barrow Strait												
*4642	Ellesmere Island												
*46421	South East Ellesmere Island	532			X								X
*46422	South West Ellesmere Island	1260			X								X
*46423	Raanes and Svendsen Peninsulas	236			X								X
*46424	Fosheim Peninsula	163			X								X
*46425	Northern Ellesmere Island				P								P
*46426	Kane Basin												
*46427	Smith Sound												
*46428	Coburg Island	92		P	P	P	P	P	P	P	P	P	P
*46460	Devon Island	1852	2.0	P									
*46461	Calf and North Kent Islands	68	2.2										
*4648	Parry Islands												
*4644	Axel Heiberg Island	1121	4.0										
*46441	Steacie Ice Cap	210	4.1	X	X	X	X	X	X	X	X	X	X
*46442	Western Axel Heiberg Island	152	4.3	X	X	X	X	X	X	X	X	X	X
*46443	Northern Axel Heiberg Island	158	4.4	X	X	X	X	X	X	X	X	X	X
*46444	McGill Ice Cap	594	4.1-3	X	X	X	X	X	X	X	X	X	X

Figure 6.3-1 Canadian Glacier Inventory

Water Survey Basin Number	Name	Number of Glaciers	Map Number	Coordinates	Orientation	Snow Line	Date	Length Width	Area	AAR	Depth	Volume	Classification
*46445	Eastern Axel Heiberg Island	7	4.4	X	X	X	X	X	X	X	X	X	X
*46446	Meighen Island												
10TD	Islands between M'Clintock Channel and Baffin Island												
*4630	Islands in Foxe Basin												
*4653	Somerset Island												
*4655	Prince of Wales Island												
*4657	King William Island												
10TE	Baffin Island Region	10789	5.0										
*46201	Bylot Island	575	5.1	X	X								
*46202	Northern Baffin Island	2802	5.2-8	X	X								
*46203	North Central Baffin Island	1851	5.9-14	X	X								
*46204	South Central Baffin Island	4302	5.15-20	X	X								
*46205	Southern Baffin Island	1259	5.21-24	X	X								
3	Labrador												
5	Nelson River Basin	1520	7.0										
5A	Oldman River	57	7.1	X	X	X	X	X	X	X	X	X	X
5B	Bow River	467	7.2-3		X								X
5C	Red Deer River	67	7.3		X								X
5D	North Saskatchewan River	929	7.4		X								X
6	Churchill and Thelon Rivers												

Figure 6.3-1 Canadian Glacier Inventory (Cont.)

Water Survey Basin Number	Name	Number of Glaciers	Map Number	Coordinates	Orientation	Snow Line	Date	Length Width	Area	AAR	Depth	Volume	Classification
7	Slave River												
7A	Athabasca River												
7E	Finlay River												
7F	Peace River												
7G	Smoky River												
7Ø	Hay River												
8	Pacific Ocean												
8A	St. Elias Range												
8B	Chatham Strait												
8C	Stikine River												
8D	Portland Canal												
8E	Skeena River												
8F	Queen Charlotte Sound												
8G	Homathko River												
8H	Vancouver Island	219	8.8	X	X	X	X	X	X	X	X	X	X
8J	Nechako River												
8K	Upper Fraser River												
8L	Thompson River												
8M	Lower Fraser River				P			P	P				P
8N	Columbia River				P								P
8Ø	Queen Charlotte Islands												
8P	Skagit River												

Figure 6.3-1 Canadian Glacier Inventory (Cont.)

Water Survey Basin Number	Name	Number of Glaciers	Map Number	Coordinates	Orientation	Snow Line	Date	Length Width	Area	AAR	Depth	Volume	Classification
9	Yukon River												
9A	Teslin River												
9B	Pelly River												
9C	White River			P	P	P	P						P
10	Mackenzie District												
10A	Hyland River												
10B	Liard River												
10C	Fort Nelson River												
10D	Petitot River												
10E	South Nahanni River												
10G	Mackenzie River												
10H	Redstone River												
10K	Mountain River												
10L	Arctic Red River												
10M	Peel River												
10S	Committee Bay												
*490	Alaska												

Correct to July, 1972

Figure 6.3-1 Canadian Glacier Inventory (Cont.)

6.4 Users

The processed, published data are distributed to about 800 interested individuals and organizations throughout the world. The principal exchanges of data in Canada occur within the federal government and also with universities, the Arctic Institute of North America, Archives of the Canadian Rockies, and private individuals. The international distribution includes three World Data Centres for Glaciology at Seattle (U.S.A.), Moscow (U.S.S.R.) and Cambridge (U.K.), and several other international and national groups, universities and private individuals.

6.5 Plans

A PDP8/I computer interfaced with a D-mac pencil follower is used to abstract data from the glacier inventory work maps. When more data are acquired through the inventory, a more sophisticated data analysis program will be developed than that currently available. An information retrieval system is being developed for glaciological literature, and this will be linked with the WATDOC reference system.

For the combined balance studies, models of accumulation, ablation and radiation patterns on the glacier surface are being tested with a view to reducing the data acquisition requirements, and to improve processing and analysis. Computer maps will be used to show the accumulation, ablation and mass balance patterns over the glacier and variations in the snowline.

For the Applied Hydrology Division, glacier surveys will be continued with the same data being collected. No changes are contemplated in the method of presenting data.

6.6 References

1. Løken, O.H., *Research Projects in Glaciology, 1972.* Inland Waters Directorate Report Series No. 23, Environment Canada, Ottawa, 115 pp.

2. Campbell, P.I., I.A. Reid and J. Shastal, *Glacier Survey in Alberta.* Inland Waters Directorate Report Series No. 4, Department of Energy, Mines and Resources, Ottawa, 1969, 66 pp.

   Reid, I.A., and J. Shastal, *Glacier Surveys in British Columbia - 1968.* Inland Waters Directorate Report Series No. 10, Department of Energy, Mines and Resources, Ottawa, 1970, 26 pp.

   Glossop, J., G.H. Morton, J.E. Anderson, F. Slobosz and V. Clayton, *1968 Report - Survey of Glaciers on the Eastern Slopes of the Rocky Mountains in Banff and Jasper National Parks.* Water Survey of Canada, Inland Waters Directorate, Department of Energy, Mines and Resources, Calgary, 1968, 29 pp.

Ommanney, C.S.L., *Glacier Surveys by District Personnel of the Water Survey of Canada*, 1. *The Victoria Glacier*, 2. *Peyto Glacier*. Glacier Inventory Notes Nos. 6 and 7, Inland Waters Directorate, Environment Canada, Ottawa, 1972, 20 pp.

Reid, I.A., and J.O.G. Charbonneau, *Glacier Surveys in Alberta - 1971*. Inland Waters Directorate, Environment Canada, Ottawa, 1972.

Reid, I.A., *Glacier Surveys by the Water Survey of Canada. Measurement and Forecasting Specific to Glaciers*. International Symposia on the Role of Snow and Ice in Hydrology, Sympesium on Measurement and Forecasting.

3. Ommanney, C.S.L., J. Clarkson and M.M. Strome, *Information Booklet for the Inventory of Canadian Glaciers*. Glacier Inventory Note No. 4, Inland Waters Directorate, Department of Energy, Mines and Resources, Ottawa, 1970, 68 pp.

4. Ostrem, G., and A. Stanley, *Glacier Mass-Balance Measurements - a manual for field and office work*. Inland Waters Directorate Reprint Series No. 66, Environment Canada, Ottawa, 1969, 118 pp.

7.0 The Great Lakes (STAR/EROS System)

7.1 STAR/EROS Data System

Data collected from Great Lakes vessel surveys for the Inland Waters Branch/Directorate have been filed under the STAR code system (1) since the surveys began in 1967. In addition, the same system stores data collected on contract by the Great Lakes Institute, University of Toronto, from 1960 to the present.

STAR is a card-based code system of data entry, with the basic layouts of the cards somewhat modified. The Canada Centre for Inland Waters (CCIW) at Burlington, Ontario, has developed a storage/retrieval system for this extensive data base, using the modified fixed format cards, which are punched from special coding sheets, as the input medium. Thereafter, tape is used for long-term storage, and a tape/disc system (EROS) for retrieval.

The STAR system provides up to 999 codes for the data that are collected. At present, about 18 per cent of the possible codes are in use, primarily for storing water quality data (see Table 7.7-1).

7.2 Procedures

Data are collected by survey vessels, fixed moorings of instruments in the lakes and other studies to develop a body of information for pollution abatement and water management programs on the Great Lakes. The patterns of the cruises made by the vessels vary according to the needs (Figure 7.2-1 shows one of the many patterns). Latitude and longitude, depths, secchi depths, mean corrected temperature and turbidity are recorded for each station, in addition to the parameters derived from subsequent analysis of the samples.

The samples are collected at a range of depths from 1 to 250 metres, where the depth of water permits, using Knudsen and Van Dorn bottles. Oceanographic reversing thermometers and rubber bulbs for bacteriological sampling are mounted on the Knudsen bottles.

Initially, the data are entered on the specially laid out coding sheets. These entries are made either on board the survey vessels or in the laboratory. Cards are then punched from the sheets, and the cards are then used to set up the STAR tape file.

In the STAR/EROS storage/retrieval system developed at CCIW, the data

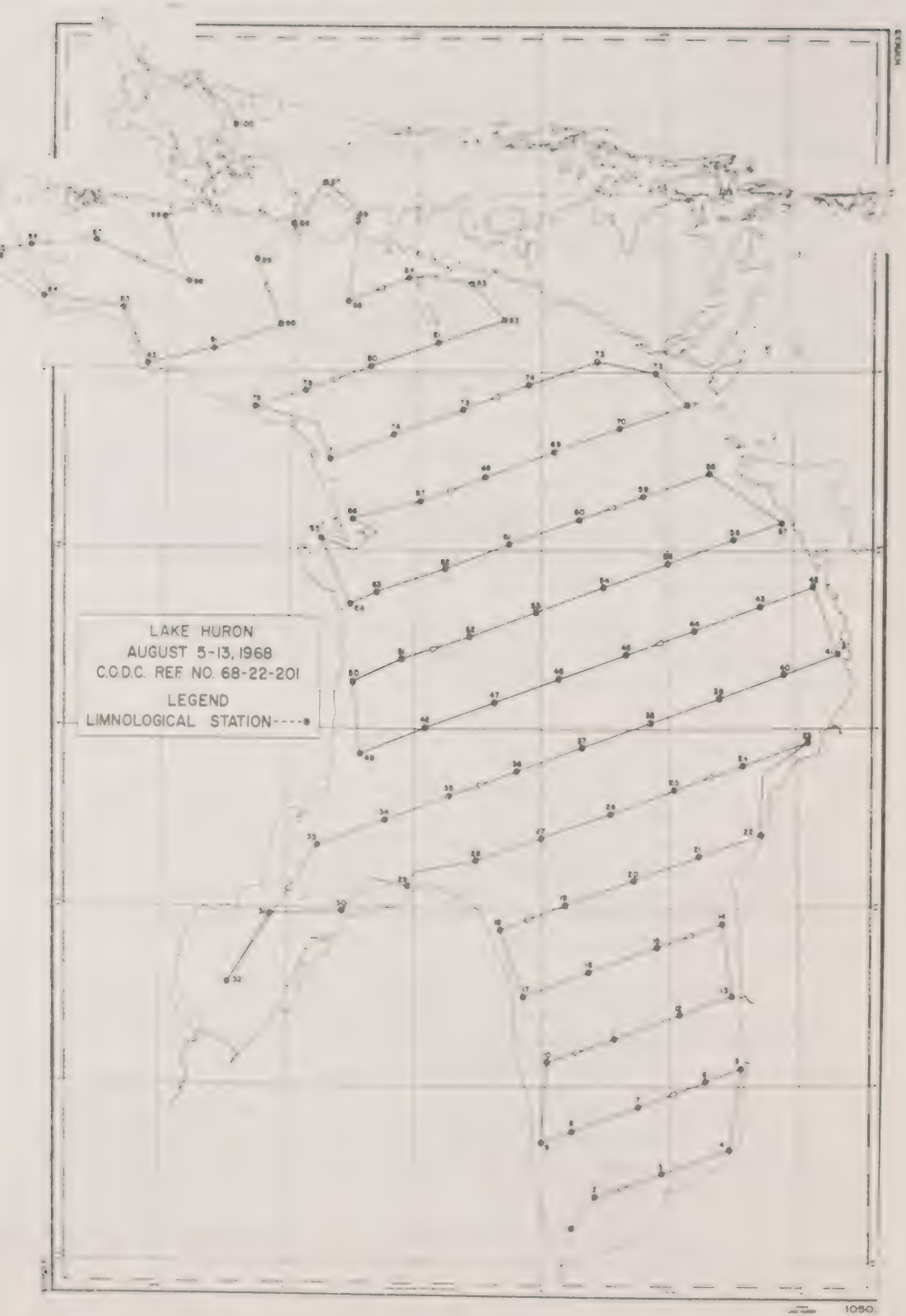


Figure 7.2-1. One of the many cruise patterns of the survey vessels.

are entered hierarchically: lake/year/cruise number/station number/depth/code-value pair. The variables are identified by a three-digit code, and five characters of information are allowed. The code number permits implied decimal points to enter the tape file, which has three characters for code and seven for floating point value. This method also allows a code library to be set up, consisting of the code number, implied decimal point and alpha-numeric descriptor.

7.3 Availability

Data on the standard STAR system files cover Lakes Ontario, Erie, Huron and Superior, and Georgian Bay, for most years from 1966 to the present. Data collected before 1966 have not been put into the new format to fit the current STAR system, but this will be done early in 1973.

The STAR system produces a "Provisional Listing" of data when the cruise file is created or updated. This is simply a tabular listing of the parameters measured, and their values, with suitable station headers and depth identification (see Figure 7.3-1).

The "Provisional Listings" are updated and documented, and when the data base is considered stable, it is converted for publication in the "Limnological Data Report" series, which is issued by the Canadian Oceanographic Data Centre on behalf of CCIW. These reports contain both a tabular listing of data and a section documenting the data. The reports are currently available from 1966 to 1969.

The parameters that have been measured, numbering about 180 out of a possible total of 1,000, are described in the "STAR Code Library for the Canada Centre for Inland Waters" (1). A list of the codes used is given below in section 7.7.

The data base can be accessed by the EROS retrieval system to allow subfiles to be created for listings, displays or analyses.

Enquiries should be addressed to the Data Processing and Display Group, Lakes Division, Canada Centre for Inland Waters, Box 5050, Burlington, Ontario. (Telephone: 416-637-4292).

7.4 Users

The present users of the STAR/EROS data system include the staff of the Canada Centre for Inland Waters, and other federal departments, universities, industry, U.S. federal and state government agencies, and U.S. university personnel.

F NO 201
CTN NO 020
COUNTRY 18
INSTITUTE 22

LAT 44-04-42N
LON 082-08-36W

YEAR 1968
MONTH 08
DAY 07
TIME 0701

NO. DEPTHS 08
SOUNDING 0972
BT SLIDE NO 020

DEPTH	SECCHI	FOREL	TEMP	T CLAS	TURB	CON 25	O2 W	T PO4
1.0			18.47	0.02	0.1	201	9.66	0.027
5.0			18.44	0.02	0.1	199	9.66	
10.0			17.87	0.00	0.1	200	9.82	
20.0			10.49	0.04	0.1	200	12.93	0.033
30.0			6.27	0.01	0.5	201	13.52	
50.0			4.38	0.03	0.5	201	12.78	
75.0			4.17	0.00	0.6	202	12.65	
96.0			4.12	0.01	4.0	200	12.31	0.033

DEPTH	SR PO4	TFNO3	R SIO2	CHLORA	MF COL	MF FCO	SPC 20	SPC 35
1.0	0.001	0.190	1.140					
5.0								
10.0								
20.0	0.001	0.230	1.800					
30.0								
50.0								
75.0								
96.0	0.000	0.180	1.200					

DEPTH		F RES	TT ALK	S SO4	CA NFA	MG NF	K NFS	NA NFS
1.0		96.0	78.5	18.4	31.100	6.300	0.820	3.100
5.0								
10.0								
20.0		93.0	77.9	17.7	30.700	6.500	0.820	3.100
30.0								
50.0								
75.0								
96.0		126.0	77.3	22.6	30.700	6.400	0.860	3.100

DEPTH	PH 25	F	CL	HARD
1.0	8.100	0.065	5.9	103.6
5.0				
10.0				
20.0	8.100	0.074	5.9	103.5
30.0				
50.0				
75.0				
96.0	7.800	0.070	6.1	103.0

Figure 7.3-1. Sample of STAR data from the "Provisional Listing" in Limnological Data Report No. 1.

7.5 Plans

The STAR system is due to be completed early in 1973, and will include an automatic catalogue/index. Some modifications are planned to simplify data entry.

7.6 References

1. Weiler, H.S., *STAR Code Library for the Canada Centre for Inland Waters*, June 10, 1971.

7.7 STAR Code Library

The coding system employs modifications of some of the standard formats used also by the Canadian Oceanographic Data Centre, but the remainder of the system is completely different (see Table 7.7-1 on following pages).

Table 7.7-1 List of STAR Codes Used

Code	Abbreviation	Description
000	SOUNDING	sounding
001	DEPTH	depth
005	BT DEP	bathythermograph depth
030	SECCHI	secchi disc depth
031	FOREL-ULE	secchi disc colour (Forel-ule)
032	HAZEN	colour, Hazen scale
100	TEMP	water temperature
104	T EBT	temperature, EBT
105	BT TEMP	bathythermograph temperature
109	T CLASS	temp. precision classification
122	I-TURB	turbidity from integ. samples
123	TURB	turbidity
159	I-SP CON	specific conductance 25°C, integ.
160	SP CON	specific conductance 25°C
200	T RES	residue, total
201	F RES	residue, filterable
202	NF RES	residue, non-filterable
212	I-PH SITU	pH in situ from integrated sample
213	PH SITU	pH in situ
214	I-PH 25	pH at 25°C integrated sample
215	PH 25	pH at 25°C
216	PH SITU	pH in situ
217	I-PH	pH in situ from integrated sample
218	PH TEMP	temp. at which pH was measured
219	TT ALK	alkalinity, total (titrometric)
220	TC ALK	alkalinity, total (colorimetric)
223	F TC ALK	total alkalinity, filt., color
227	C TP	carbon, total particulate
228	C INORG	inorganic carbon
229	C TOT	total carbon
230	ORG C	carbon, total organic
231	T CO2	total carbon dioxide
232	H CO3	bicarbonate
233	H CO3 F	bicarbonate, filtered
239	BOD W	biochemical oxygen demand
240	BOD P	biochemical oxygen demand (probe)
245	D 02 W	oxygen, concentration dissolved
247	SAT 02	oxygen, % saturation of dissolved
260	T P	phosphorus, total
261	S P	phosphorus, soluble unreactive

Table 7.7-1 List of STAR Codes Used (Cont.)

Code	Abbreviation	Description
262	RP	phosphorus, reactive
263	SR P	phosphorus, soluble reactive
264	TF P	total phosphorus, filtered
268	N TP	nitrogen, total particulate
269	TNF N	total nitrogen, non-filtered
270	NH3	ammonia nitrogen, soluble
271	NO3 NF	nitrate nitrogen, non-filtered
272	NO3 F	nitrate nitrogen, filtered
273	NO2 NF	nitrite nitrogen, non-filtered
274	NO2 F	nitrite nitrogen, filtered
275	T NO3	nitrate + nitrite nitrogen, n-f
276	TF NO3	nitrate + nitrite nitrogen, f
277	TKJ N	total Kjeldahl nitrogen, n-f
278	ORG N	organic nitrogen, non-filtered
279	F ORG N	organic nitrogen, filtered
280	SO4 NF	sulphate, non-filtered
281	RS	sulphide, non-filtered
282	TF N	total nitrogen, filtered
283	SO4 F	sulphate, filtered
284	CL F	chloride, filtered
288	F F	fluoride, filtered
298	F	fluoride, non-filtered
290	CL	chloride, non-filtered
292	I	iodide, non-filtered
295	R SIO2	silica, soluble reactive
296	T SIO2	silica, total
300	HARD	hardness, total
320	CD NF	cadmium, non-filtered
321	CD F	cadmium, filtered
324	CA NFA	calcium, non-filtered (at. absorption)
325	CA FA	calcium, filtered (atomic absorption)
328	CR NF	chromium, non-filtered
329	CR F	chromium, filtered
332	CO NF	cobalt, non-filtered
333	CO F	cobalt, filtered
336	CU NF	copper, non-filtered
337	CU F	copper, filtered
340	FE NF	iron, non-filtered
341	FE F	iron, filtered
342	FE TS	iron, total soluble
343	FE T	iron, total

Table 7.7-1 List of STAR Codes Used (Cont.)

Code	Abbreviaton	Description
346	LB NF	lead, non-filtered
347	LB F	lead, filtered
350	LI NF	lithium, non-filtered
351	LI F	lithium, filtered
354	MG NF	magnesium, non-filtered
355	MG F	magnesium, filtered
356	MN TS	manganese, total soluble
357	MN T	manganese, total
358	MN NF	manganese, non-filtered
359	MN F	manganese, filtered
360	HG NF	mercury, non-filtered
361	HG F	mercury, filtered
362	MO NF	molybdenum, non-filtered
363	MO F	molybdenum, filtered
366	NI NF	nickel, non-filtered
367	NI F	nickel, filtered
372	K NFS	potassium, non-filtered (p.m.)
373	K FS	potassium, filtered (photometric)
388	NA NFS	sodium, non-filtered (photometric)
389	NA FS	sodium, filtered (photometric)
390	SR NFA	strontium, n.f. (atomic absorption)
391	SR FA	strontium, filtered (atomic absorp.)
392	SR NFS	strontium, n.f. (photometric)
393	SR FS	strontium, filtered (photometric)
396	V NF	vanadium, non-filtered
397	V F	vanadium, filtered
398	ZN NF	zinc, non-filtered
399	ZN F	zinc, filtered
405	BOR	boron
410	PHEN	phenolic compounds
610	CHLORA	chlorophyll A
700	MF COL	MF coliform
701	MPNCOL	MPN coliform
703	MF FCO	MF fecal coliform
704	MPNFCO	MPN fecal coliform
706	MF STR	MF fecal streptococci
707	MPNSTR	MPN fecal streptococci
720	SPC 20	standard plate count at 20°C

Table 7.7-1 List of STAR Codes Used (Cont.)

Code	Abbreviation	Description
721	SPC 35	standard plate count at 35°C
971	MF 20 FT	aerobic viable count MF 20°C
972	MF AMMOX	autotrophic ammonium-oxidizing bact.
973	MPN PROTEUS	MPN Proteus
974	PROT P/A	Proteus per 100 ml, filtered
975	BACT BIO	bacteria, biomass
976	MF 4 FT	aerobic viable count MF 4°
977	AN MF 20	anaerobic viable count MF 20°
978	DC MF	direct count MF/ml
984	PSEUD-MF	pseudomonas species, MF

8.0 Water Quality (NAQUADAT System)

8.1 National Water Quality Data Bank (NAQUADAT)

For the past two years, the Water Quality Branch of the Inland Waters Directorate has been operating a data storage and retrieval system, known as NAQUADAT (National wAter QUAlity DATa bank) (1). Before this system was developed, an interdepartmental task force had set down some guidelines for the storage and retrieval of all types of scientific data collected from field surveys. Examples of these guidelines are the use of latitude and longitude for storing the location of the field site, and the use of time, rather than sample number, as a key variable.

The system employs an IBM 360/85 computer in Ottawa, with data inputs from the Branch's four laboratories at Vancouver, Calgary, Burlington and Moncton. As a large proportion of the samples being analyzed in these laboratories are for other federal and provincial agencies, the system now contains a large amount of water quality data that are relevant on both the national and local scales.

Identical systems are being operated by provincial agencies at Winnipeg, Edmonton and Saskatoon.

The central Ottawa system will soon be acting as a water quality data bank for all of the Atlantic Provinces to store both federal and provincial data. NAQUADAT is capable of storing all types of water-relevant analyses (chemical, physical, bacteriological, biological and hydrometric) for surface water, ground water, waste water and sediments (2).

8.2 Procedures

The NAQUADAT system is designed to accept input data in free format on punched cards or magnetic tapes. Each piece of data is associated with the appropriate code. Most of the Water Quality Branch data are produced at present from laboratory analyses of manually collected samples. The analytical results are entered in the laboratory on precoded forms, which can be sent directly for keypunching.

Results from other agencies that are not using the NAQUADAT format, or results from the years before the system was introduced, are transferred manually to special, but similar, coded sheets.

8.3 Availability

A summary of all data collected by the Water Quality Branch and other agencies, and stored in NAQUADAT, is given in Table 8.3-4 at the end of this section, (page 50). The entries in the table include:

(i) the surface water basins for each province,
(ii) projects and/or sampling networks,
(iii) the water quality parameters measured for each project network,
(iv) the frequency and period of sampling for each project network.

At the present time, the system offers three types of retrieval reports:

- Water Quality Data Listing,
- Water Quality Data Summary,
- Nutrient Loadings.

The Data Listing is a printout of up to eight water quality parameters per page, against time. It may contain any number of eight parameter groups for any number of stations. At the beginning of the report, there is a guide to reading the report and a list of the stations retrieved. For a sample of a Data Listing see Figure 8.3-1.

The Data Summary is a printout of up to 30 water quality parameters per page as statistical summaries, consisting of the number of determinations, high and low values, and the 10th, 25th, 50th (median), 75th and 90th percentile values. Any number of stations may be retrieved in a single report. At the beginning of each report, there is a guide to reading the report and a list of stations retrieved. One section of a printout is shown in Figure 8.3-2.

The Nutrient Loadings method of retrieval can only be used when data for daily flow, total carbon, total phosphorus and total nitrogen are stored in the system for the requested station and time period. The retrieval program computes and accumulates total nutrient loadings over given time intervals. This method is used principally for special water management problems where the nutrient contributions from various sources need to be determined and compared for a given time period. An example from a printout is shown in Figure 8.3-3.

Retrieval reports can be obtained by writing to the Head, Data and Instrumentation Subdivision, Network and Surveys Division, Water Quality Branch, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario. (Telephone 819-997-3422). The time period(s), the station, the parameter names and/or numbers must be specified.

A "Water Quality Dictionary", giving the coding system used to identify methods of analysis and the respective parameter code numbers, and a regional "Index of National Water Quality Network Stations" are also obtainable from the same source.

WATER QUALITY DATA REQUEST 0001 PAGE 4

LAKE WINNIPEG/CHURCHILL-NELSON RIVERS

STATION 00MA05KJ0001 LATITUDE 53D 50M 30S LONGITUDE 101D 11M 05S

SASKATCHEWAN RIVER AT THE PAS,MANITOBA

SAMPLE DATE	TIME CST	02061F TEMPERATURE DEG.C.	02011L COLOUR APPARENT REL. UNITS	02073L TURBIDITY TOTAL TURBIDITY UNITS	10301L PH PH UNITS	02041L SPECIFIC CONDUCTANCE UMHO/CM	10603L HARDNESS TOTAL CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	00201L TOTAL SOLIDS MG/L
[illegible]		21	20.	60.	8.0	296		111	
[illegible]		21	10.	70.	7.9	283		111	
[illegible]		17	10.	44.	7.5	324		118	
[illegible]		9	5.	25.	7.9	388		116	
[illegible]		[illegible]	15.	10.	8.	510		157	
[illegible]		1	10.		7.7	569		195	
[illegible]		1	5.	4.	7.5	672		235	
[illegible]	12 00	1	5.	9.0	8.2	625		214	
[illegible]		1	0.05	0.4	7.8	529		181	
[illegible]		[illegible]	0.0	4.5	7.7	496		171	
[illegible]		[illegible]		325.	7.6	361		109	
[illegible]		17	15.	235.	7.7	387		131	
[illegible]		18	10.	88.	8.1	339		121	
[illegible]	12 00	[illegible]	20.	16.	7.9	418		117	
[illegible]		[illegible]	25.	100.	7.9	651		199	
[illegible]		1	20.	4.0	7.8	502		165	
[illegible]		1	20.	5.7	8.2	562		190	
[illegible]		16	0.10	24.	8.	357		132	
[illegible]		10	5.	235.	4.	1032			
[illegible]		[illegible]	0.10	2.9	7.7	485		162	
[illegible]		[illegible]	0.25	43.0	7.2	387		127	
[illegible]		7	0.45	38.	7.7	506		139	
[illegible]		[illegible]	0.25	2.8	7.6	459		159	
[illegible]		11	0.25	57.	8.4	377		147	
[illegible]		1	0.15	8.3	7.1	482		158	
[illegible]		[illegible]	10.	1.2	8.5	497		181	
[illegible]		[illegible]	50.	156.	7.9	438		132	
[illegible]		[illegible]	50.	156.	7.9	438		132	
[illegible]		17	45.	12.	7.6	427		160	
[illegible]		17	0.45	1.2	7.6	427		160	

Figure 8.3-1. Sample of a Water Quality Data listing.

WATER QUALITY DATA SUMMARY REPORT
FOR 01/01/60 TO 02/03/72 EST

REQUEST 0001 PAGE

STATION 00UN02AD0001 LATITUDE 49D 19M 0S LONGITUDE 88D 17M 30S

NIPIGON RIVER AT PINE PORTAGE,ONTARIO

	02061S TEMPERATURE	02061L TEMPERATURE	02041L SPECIFIC CONDUCTANCE	00201L TOTAL DISSOLVED SOLIDS	10301L PH	02073L TURBIDITY TOTAL	02011L COLOUR APPARENT	10101L ALKALINITY TOTAL	10151L ALKALINITY PHENOL	10401L RESIDUE NONFILTER.
	DEG.C.	DEG.C.	UMHO/CM	MG/L	PH UNITS	TURBIDITY UNITS	REL. UNITS	CACO3 MG/L	CACO3 MG/L	MG/L
SAMPLES	21	21	21		21	21	21	21	21	
LOW	1	22	45		6.5	0.2	5.	10	0.0	
HIGH	23	25	459		8.2	1.6	30.	72	0.0	
PERCENTILES										
10TH	1	22	55		7.1	0.2	5.	17	0.0	
25TH	2	22	66		7.2	0.2	5.	20	0.0	
MEDIAN 50TH	5	23	142		7.6	0.4	10.	67	0.0	
75TH	12	25	146		7.7	0.6	20.	69	0.0	
90TH	17	25	149		7.9	0.9	25.	71	0.0	
BACKUP CODES 61F										

	10501L RESIDUE FIXED NONFILTER.	10451L RESIDUE FILTERABLE	10551L RESIDUE FIXED FILTERABLE	08401L OXYGEN CONSUMED	06201L BICARBONATE	06301L CARBONATE DISSOLVED	10093L HARDNESS TOTAL	20191L CALCIUM DISSOLVED	12101L MAGNESIUM DISSOLVED (CALCULATED)	11101L SODIUM DISSOLVED
				O2	HCO3	CO3	CACO3	CA	MG	NA
	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES		13	13	20	21	21	21	21		21
LOW		40.4	22.0	2.9	13	0	18.7	7.1		0.7
HIGH		92.0	80.0	8.3	87	0	76.0	27.7		2.0
PERCENTILES										
10TH		49.3	24.6	4.1	20	0	27.0	7.6		0.7
25TH		52.8	33.2	4.9	25	0	33.6	12.8		0.8
MEDIAN 50TH		71.2	45.6	5.2	82	0	69.9	22.7		1.1
75TH		89.2	70.4	5.9	84	0	72.9	26.3		1.4
90TH		92.	75.	7.2	87	0	75.6	27.7		1.8
BACKUP CODES										

	19103L POTASSIUM DISSOLVED	14102L SILICA REACTIVE	17203L CHLORIDE DISSOLVED	09105L FLUORIDE DISSOLVED	16303L SULPHATE DISSOLVED	07001L NITROGEN TOTAL KJELDAHL	07105L NITROGEN DISS.NITRATE & NITRITE	07103L NITRATE & NITRITE DISSOLVED	15403L PHOSPHATE TOTAL	15303L PHOSPHATE TOTAL INORGANIC
	K	SIO2	CL	F	SO4	N	N	NO3	PO4	PO4
	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
SAMPLES	21	21	21	21	21			21	3	
LOW	0.4	3.6	0.2	0.02	3.3			0.00	0.05	
HIGH	0.8	4.8	1.7	0.12	10.9			0.51	0.05	
PERCENTILES										
10TH	0.5	3.3	0.4	0.04	3.6			0.10		
25TH	0.5	3.5	0.4	0.04	4.0			0.17		
MEDIAN 50TH	0.6	3.7	1.0	0.05	5.3			0.30	0.05	
75TH	0.6	3.9	1.1	0.05	9.0			0.43		
90TH	0.7	4.3	1.2	0.10	9.3			0.46		
BACKUP CODES				04L						

Figure 8.3-2. Sample of a Data Summary printout.

FOR PERIOD 060470 TO 310570

CUMULATIVE POUNDS OF NUTRIENT BETWEEN 06 04 1970 AND DATE SHOWN

DATE	TOTAL NITROGEN	TOTAL CARBON	TOTAL PHOSPHATE
06 04 1970 CST	0	0	0
31 05 1970 CST	696.000	4,030.000	538.000

005A05JK0002 QUAPPELLE RIVER AT NO 6 HIGHWAY CROSSING, SASKATCHEWAN

CUMULATIVE POUNDS OF NUTRIENT BETWEEN 06 04 1970 AND DATE SHOWN

DATE	TOTAL NITROGEN	TOTAL CARBON	TOTAL PHOSPHATE
06 04 1970 CST	0	0	0
31 05 1970 CST	500.000	2,860.000	349.000

CUMULATIVE POUNDS OF NUTRIENT BETWEEN 06 04 1970 AND DATE SHOWN

DATE	TOTAL NITROGEN	TOTAL CARBON	TOTAL PHOSPHATE
06 04 1970 CST	0	0	0
31 05 1970 CST	456.000	3,040.000	394.000

005A05JK0005 ECHO CRLEK NEAR MOUTH AT NO 10 HIGHWAY SASKATCHEWAN.

CUMULATIVE POUNDS OF NUTRIENT BETWEEN 06 04 1970 AND DATE SHOWN

DATE	TOTAL NITROGEN	TOTAL CARBON	TOTAL PHOSPHATE
06 04 1970 CST	0	0	0
31 05 1970 CST	76.300	678.000	72.600

Figure 8.3-3. Sample of a Nutrient Loadings printout.

8.4 Users

The present users of NAQUADAT include the headquarters and regional services of Environment Canada, other federal departments, provincial agencies, universities, consultants, municipal waterworks and industry.

8.5 Plans

New developments for the NAQUADAT system scheduled for 1972-73 include the following:

(i) graphical reporting of water quality data and loadings against time and river mileage;

(ii) addition to the parameter coding system to permit storage of bacteriological, biological and sediment data;

(iii) computerization of the NAQUADAT Data Catalogue, which is presented in this publication.

8.6 References

1. Demayo, A., *A Storage and Retrieval System for Water Quality Data*. Inland Waters Branch, Department of Energy, Mines and Resources, Report Series No. 9, 1970, Ottawa.

2. Peters, R.H., and A. Demayo, *Storage and Retrieval of Water Quality Data*. Proceedings of a workshop seminar on computer storing and processing of hydrological data, Quebec, 1971. Available in Inland Waters Directorate, Environment Canada, Reprint No. 165, Ottawa.

Table 8.3-4 Water Quality Data Holdings

The following table summarizes all data collected by the Water Quality Branch and other agencies, and stored in NAQUADAT. An explanation of the entries in the table is given below:

RIVER BASIN:

Surface water basins for each province with the basin codes that are incorporated into each station code number. The codes are those used by Water Survey of Canada for storing hydrometric data.

PROJECT:

Projects or sampling networks operated by the Water Quality Branch, or for the Branch by another agency.

PARAMETERS MEASURED:

A - All samples are analyzed for calcium, magnesium, sodium, potassium, silica, chloride, sulphate, nitrate, carbonate, bicarbonate, pH, specific conductance, colour, turbidity, total alkalinity, and hardness. In addition, about every third sample is analyzed for extractable and dissolved iron, extractable and dissolved manganese, fluoride, ortho-phosphate, nitrate + nitrite, and residue on evaporation at 105°C.

J - All samples are routinely analyzed by the Water Quality Branch, Ontario Ministry of the Environment, for 5-day BOD, total and suspended dissolved solids, turbidity, conductivity, total and soluble phosphorus, free ammonia, total kjeldahl nitrogen, nitrite, nitrate, hardness, chlorides, alkalinity, pH, calcium, magnesium, sodium, potassium, silica, sulphate, colour, nickel and chemical oxygen demand. In addition, two or three times per year the sample is analyzed for extractable and dissolved iron, extractable and dissolved manganese, copper, zinc, aluminum, fluoride, phenols and total coliforms.

Pesticides (& Herbicides) - Most samples are analyzed for Lindane, Heptachlor, Aldrin, DDE, DDD, DDT, Methoxychlor, Endosulfan, Endrin, Dieldrin, Chlordane, BHC, 2,4-D, and 2,4,5-T.

Table 8.3-4 Water Quality Data Holdings (Cont.)

Trace Metals - Most samples are analyzed for extractable aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, silver, strontium, thallium, vanadium, zinc and also dissolved arsenic.

Trace Organics - Most samples are analyzed for phenolic material, tannin & lignin, ligno sulphonates, hydrocarbons, humic acids, PCBs, and detergents.

Heavy Metals - Most samples are analyzed for extractable and/or dissolved copper, lead and zinc, and also usually analyzed for pH, colour, turbidity, hardness and specific conductance.

Nutrients - Most samples are analyzed for nitrate + nitrite nitrogen, total kjeldahl nitrogen, total and dissolved organic and inorganic carbon, total phosphorus, dissolved inorganic phosphorus, and dissolved orthophosphate phosphorus. Usually also includes analysis for pH, alkalinity, colour, turbidity, and specific conductance.

DO/BOD - Samples are analyzed in the field for dissolved oxygen and biochemical oxygen demand, and usually also analyzed for pH, alkalinity, specific conductance and turbidity.

Cd - cadmium.

TOC/TIC - Total organic and inorganic carbon.

Hg - mercury.

As - arsenic.

FREQUENCY OF SAMPLING:

D - Daily
W - Weekly
SM - Twice per month
M - Monthly
BM - Every two months
Q - Quarterly
P - Periodic (1 or more per year)
S - Seasonal (run-off to freeze-up)

Table 8.3-4. Alberta

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Bow River Basin					
5BB-5BN	National Network Stations	5	A + Heavy Metals + TIC/TOC*	M	66-
	Saskatchewan River, Headwater System	4	A + Heavy Metals + TIC/TOC*	M	64-
	Marmot Creek Research Basin	6	A + Heavy Metals + TIC/TOC*	W-M	63-
	Trace Metals and Pesticides Survey	12	Trace Metals + Pesticides	P	72-
	Mercury Survey 1970	6	Hg.	P	70
South Saskatchewan River Basin					
5AA-5AK	National Network Station	7	A + Heavy Metals + TIC/TOC*	M	66-
	Saskatchewan River, Headwater System	8	A + Heavy Metals + TIC/TOC*	M	64-
	Streeter Research Basin	4	A + Heavy Metals + TIC/TOC*	W-M	66-
	Trace Metals and Pesticides Survey	21	Trace Metals + Pesticides	P	72-
	Mercury Survey 1970	3	Hg.	P	70
Red Deer River Basin					
5CA-5CK	National Network Stations	4	A + Heavy Metals + TIC/TOC*	M	66-
	Saskatchewan River, Headwater System	1	A + Heavy Metals + TIC/TOC*	M	63-

* TIC/TOC 1971-72 Only

Table 8.3-4. Alberta (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Red Deer River Basin - Cont'd					
	Deer Creek Research Basin	4	A + Heavy Metals + TIC/TOC*	M	67-
	Trace Metals and Pesticides Survey	7	Trace Metals + Pesticides	P	72-
	Mercury Survey 1970	2	Hg.	P	70
North Saskatchewan River Basin					
5DC-5FA	National Network Stations	5	A + Heavy Metals + TIC/TOC*	M	66-
	Saskatchewan River, Headwater System	4	A + Heavy Metals + TIC/TOC*	M	64-
	Trace Metals and Pesticides Survey	4	Trace Metals + Pesticides	P	72
	Mercury Survey 1970	7	Hg.	P	70
Beaver River Basin					
6AD	National Network Station	1	A + Heavy Metals	M	67-70
	Trace Metals and Pesticides Survey	1	Trace Metals + Pesticides	P	72-
Athabasca River Basin					
7AD-7DD	National Network Stations	8	A + Heavy Metals + TIC/TOC*	M	66-
	Eastern Slopes, Headwater System	1	A + Heavy Metals + TIC/TOC*	M	66-

*TIC/TOC 1971-72 Only

Table 8.3-4. Alberta (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq	Period of Record
Athabasca River Basin - Cont'd					
	Tri-Creek Research Basin	3	A + Heavy Metals + TIC/TOC*	SM	67-
	Cache Percotte Research Basin	3	A + Heavy Metals	P	67-70
	Trace Metals and Pesticides Survey	8	Trace Metals + Pesticides	P	72-
	Mackenzie River Basin Project	14	A + TIC/TOC + Trace Metals	P	69
Peace River Basin					
7HE 7KE	National Network Stations	6	A + Heavy Metals + TIC/TOC*	M	66-
	Spring Creek Research Basin	5	A + Heavy Metals	SM	68-69
	Trace Metals and Pesticides Survey	6	Trace Metals + Pesticides	P	72-
	Mackenzie River Basin Project	17	A + TIC/TOC + Trace Metals	P	69
Slave River Basin					
7NA 7OC	National Network Station	1	A + Heavy Metals + TIC/TOC*	M	60-
	Mackenzie River Basin Project	5	A + TIC/TOC + Trace Metals	P	69
Milk River Basin					
11AA	National Network Stations	3	A + Heavy Metals + TIC/TOC*	M	60-
	Trace Metals and Pesticides Survey	3	Trace Metals + Pestices	P	72

* TIC/TOC 1971-72 Only

Table 8.3-4. British Columbia

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Columbia River Basin					
8NB-8NN	National Network Stations	22	A + Heavy Metals + TIC/TOC*	M	61-
	Okanagan Basin Study	42	A + Heavy Metals + DO/BOD	W-BM	69-
	Trapping Creek Research Basin	6	A + Heavy Metals	M	66-67
	Long Term Survey	4	A + Heavy Metals	Q	61-63
Fraser River Basin					
8JE-8MH	National Network Stations	9	A + Heavy Metals + TIC/TOC*	M	61-
	Long Term Survey	2	A + Heavy Metals	Q	61-63
	Mercury Survey 1970	4	Hg.	P	70
Vancouver Island					
8HA-8HD	National Network Stations	5	A + Heavy Metals + TIC/TOC*	M	67-
	Buttle Lakes Study	2	A + Heavy Metals + Nutrients	BM	68-
Squamish River Basin					
8GA	National Network Station	1	A + Heavy Metals	Q	68-70
Bella Coola River Basin					
8FB-8FD	National Network Station	1	A + Heavy Metals + TIC/TOC*	M	68-
	Long Term Survey	1	A + Heavy Metals	Q	61-62

* TIC/TOC 1971-72 Only

Table 8.3-4. British Columbia (Cont.)

Basin / Project	No. of Stns	Parameters Measured	Sampling Freq.	Period of Record
Skeena River Basin				
8EB-8EG National Network Stations	7	A + Heavy Metals + TIC/TOC*	M	67-
Long Term Survey	2	A + Heavy Metals	M	60-63
Nass River Basin				
8DB National Network Station	1	A + Heavy Metals + TIC/TOC*	M	67-
Stikine River Basin				
8CE-8CG National Network Stations	2	A + Heavy Metals + TIC/TOC*	Q	67-
Taku River Basin				
8BB National Network Station	1	A + Heavy Metals + TIC/TOC*	P	70
Peace River Basin				
7EB-7FD National Network Station	1	A + Heavy Metals	P	60-69
Long Term Survey	1	A + Heavy Metals	Q	61-63
Mackenzie River Basin Project	8	A + TIC/TOC + Trace Metals	P	69
Liard River Basin				
10AA-10DA Mackenzie River Basin Project	10	A + TIC/TOC + Trace Metals	P	69

* TIC/TOC 1971-72 Only

Table 8.3-4. Manitoba

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Red River Basin					
5OA-5OJ	National Network Stations	6	A + Heavy Metals* + TIC/TOC*	M	60-
	Lake Winnipeg Study	1	Nutrients	W-M	69-
	Long Term Survey	4	A + Heavy Metals	W-P	63-66
	Mercury Survey 1970	3	Hg.	P	70
Assiniboine River Basin					
5JM-5MJ	National Network Stations	6	A + Heavy Metals* + TIC/TOC*	M	60-
	Qu'Appelle Basin Study	1	A + DO/BOD + Nutrients	W-M	70-72
	Mercury Survey 1970	3	Hg,	P	70
	Potash Study 1971	1	A + Heavy Metals + Nutrients, DO/BOD	P	71
Souris River Basin					
5NF-5NG	National Network Stations	2	A + Heavy Metals* + TIC/TOC*	M	60-
	Long Term Survey	2	A + Heavy Metals	W-P	63-66
Dauphin River Basin					
5LC-5LM	National Network Stations	6	A + Heavy Metals* + TIC/TOC*	M	67-
Saskatchewan River Basin					
5KJ	National Network Station	1	A + Heavy Metals* + TIC/TOC*	M	61-

* Heavy Metals, TIC/TOC, 1972 Only

Table 8.3.4. Manitoba (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Winnipeg River and Lake Winnipeg Basin					
5PF-5SH	National Network Stations	3	A + Heavy Metals* + TIC/TOC*	M	67-
	Lake Winnipeg Study	10	Nutrients	W-M	69-
	Long Term Survey	1	A + Heavy Metals	Q	60-63
	Mercury Survey 1970	2	Hg.	P	70
Nelson River Basin					
5TD-5UB	National Network Stations	10	A + Heavy Metals* + TIC/TOC*	M	66-
	Lake Winnipeg Study	1	Nutrients	W-M	69-
Churchill River Basin					
6EA-6FD	National Network Stations	6	A + Heavy Metals* + TIC/TOC*	P	71-
	Long Term Survey	1	A + Heavy Metals	M	60-63
Hay River Basin					
4AC	National Network Station	1	A + Heavy Metals* + TIC/TOC*	M	67-

* Heavy Metals, TIC/TOC, 1972 Only

Table 8.3-4. New Brunswick

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Saint John River Basin					
1AD-1AP	National Network Stations	23	A + Heavy Metals + Cd *	M	65-
	North Nashwaaksis Research Basin	2	A + Heavy Metals + Cd *	M	66-
	Lake George Antimony, Mining Area Samples	4	Heavy Metals + Antimony + Cd	M	71-
	Aroostook River Study	6	A + BOD/DO, Nutrients, Pesticides	M-P	68-69
	St. John River Study	23	A + Cd, Hg, Nutrients, DO/BOD, Pesticides, Heavy Metals, Trace Organics, Coliforms	SM	71-72
	St. John River Study	3	A + BOD/DO, Nutrients, Pesticides Heavy Metals, Trace Organics, Cd	W	71-
	St. John River Estuary Study	9	Nutrients + COD + Ligno Sulphonates	SM-M	72-
	New Brunswick Water Authority	60	Various	P	71-
	Water Quality Survey	38	Pesticides + Hg + Cd	P	72-
	New Brunswick Fish and Wildlife	19	A + Heavy Metals + Cd* + Hg*	P	70-
	City of Fredericton Water Supply	10	A + Heavy Metals + Cd	P	71-

*Hg, Cd 1971-72 Only

Table 8.3-4. New Brunswick (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Saint John River Basin (Cont'd)					
	Mactaquac Fish Culture Production	4	A + Heavy Metals + Cd	P	71
	Environmental Protection Service Cove Brook Study	5	Fenitrothion	D-P	72-

*Hg, Cd 1971-72 Only

Table 8.3-4. New Brunswick (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Southwestern New Brunswick (St. Croix River, Lepreau River, Musquash River and Passamaquoddy Bay)					
1AQ-1AR	National Network Stations	10	A + Heavy Metals + Cd*	M	68-
	Mount Pleasant Mine Area	13	Heavy Metals + Cd	M	71-
Salmon River Basin					
1BV	National Network Stations	7	A + Heavy Metals + Cd*	M	70-
	Water Quality Survey	5	Pesticides + Cd + Hg	P	72-
	Fundy National Park Survey	5	Fenitrothion	D-P	71-
Petitcodiac River Basin					
1BU	National Network Stations	7	A + Heavy Metals + Cd*	M	70-
	Water Quality Survey	3	Pesticides + Cd + Hg	P	72-
	University of Moncton (Surface Water Study)	27	Heavy Metals + TOC + Hg	P	71
Richibucto and Kouchibouguac River Basins					
1BR-1BT	National Network Stations	2	A + Heavy Metals + Cd*	M	69-
	Water Quality Survey	25	Pesticides + Cd + Hg	P	72-
	Department of Fisheries and Forestry	3	A + Heavy Metals	P	71
Miramichi River Basin					
1BM-1BQ	National Network Stations	9	A + Heavy Metals + Cd*	M	65-
	Water Quality Survey	14	Pesticides + Hg + Cd	P	72-

* Hg, Cd 1971-72 Only

Table 8.3-4. New Brunswick (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Miramichi River Basin - Cont'd					
	Heath Steel Mine, Area Samples	21	Heavy Metals + CD* + Hg*	M	67-
	Burnthill Tungsten Mine, Area Samples	5	Heavy Metals + Cd*	S	69-
	Texas Gulf Mine, Area Samples	4	Heavy Metals	S	67-
	Chester Mine, Area Samples	8	Heavy Metals	S	67-
	Municipal Water Survey	4	A + Heavy Metals + Cd	P	71
	Miramichi Fish Culture Stations	6	A + Heavy Metals	P	72-
Tabusintac, Tracadie and Caraquet River Basins					
1BI	National Network Stations	4	A + Heavy Metals + Cd*	M	70-
	Water Quality Survey	15	Pesticides + Hg + Cd	P	72-
	FENCO Groundwater Study	8	A + Heavy Metals + Cd	P	72-
Nepisiguit River Basin (Jaquet and Eel River Basins)					
1BJ 1BK	National Network Stations	5	A + Heavy Metals + Cd*	M	70-
	Water Quality Survey	22	Pesticides + Hg + Cd	P	72-
	Restigouche Mine, Area Samples	6	Heavy Metals	S-M	66-
	Anaconda Brass Mine, Area Samples	2	Heavy Metals + Cd*	M	66-
	Brunswick Mine #12, Area Samples	6	Heavy Metals, Sulphur + Cd*, Thiosulphate	M	62-

* Hg, Cd, 1971-72 Only

Table 8.3-4. New Brunswick (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Nepisiguit River Basin (Jaquet and Eel River Basins) - Cont'd					
	Nigadoo River Mine, Area Samples	5	Heavy Metals + As + Cd*	S-M	66-
	New Larder Mine, Area Samples	3	Heavy Metals	P	66-
	Wedge Mine, Area Samples	4	Heavy Metals + Cd* + Hg*	S-M	62-
	Keeway Mine, Area Samples	4	Heavy Metals	P	71-
	Brunswick Mine #6, Area Samples	18	Heavy Metals	S-M	65-
	New Brunswick Water Authority	31	Various	P	71-
	University of Moncton	6	Heavy Metals + Hg	P	71
	W.Q.D. Municipal Water Supply	5	A Heavy Metals + Cd	P	71
Restigouche River Basin					
1BC-1BE	National Network Stations	2	A + Heavy Metals + Cd*	M	65-
	Copperfield Mine, Area Samples	7	Heavy Metals	P	71-
	Water Quality Survey	2	Pesticides + Cd + Hg	P	72-

*Hg, Cd, 1971-72 Only

Table 8.3-4. Newfoundland

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Northern Newfoundland					
2YA-2YS	National Network Stations	5	A + Heavy Metals	M	66-70
	National Network Stations	11	A + Heavy Metals + Cd	M	71-
	Exploits River Basin Study	18	A + Nutrients + Heavy Metals	P	68-69
	Newfoundland Water Authority	10	A + Heavy Metals + Cd	P	71-72
	Department of Fisheries and Forestry	4	A + Heavy Metals + TOC	P	71
Southern Newfoundland					
2ZA-2ZN	National Network Stations	3	A + Heavy Metals	M	66-70
	National Network Stations	8	A + Heavy Metals + Cd	M	71-
	Newfoundland Water Authority	29	A + Heavy Metals + Hg + Cd	P	71-72
	Dept. Environment Resource Dev. Branch	14	A + Heavy Metals + TOC	P	71
	Department of Fisheries and Forestry	13	A + Heavy Metals + TOC + Trace Organics	P	71
Labrador					
3QB-3QC	National Network Stations	5	A + Heavy Metals + Cd*	P	68-
	Newfoundland Water Authority	12	A + Heavy Metals + Hg + Cd	P	71-72

* Cd 1971-72 Only

Table 8.3-4. Northwest Territories

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Great Slave Lake (Upper Mackenzie River Basin)					
70B-7SB	National Network Stations	5	A + Heavy Metals + TIC/TOC*	P	68-
	Mackenzie River Basin Project	8	A + TIC/TOC + Trace Metals	P	69
	Pine Point Mine, Area Samples	5	Heavy Metals + As + SOC + Cyanide + TOC	P	69-70
	Cominco Mine, Area Samples	3	Heavy Metals + As + SOC + TOC	P	70-71
	Giant Yellowknife Mine, Area Samples	8	Heavy Metals + As + SOC + TOC	P	68-71
Lower Mackenzie River Basin					
10EC-10NA	National Network Stations	12	A + Heavy Metals + TIC/TOC*	P	69-
	Mackenzie River Basin Project	12	A + TIC/TOC + Trace Metals	P	69
	Mackenzie Pipeline Study	20	A + TIC/TOC + As + Trace Metals	P	72-
	Canada Tungsten Mine, Area Samples	4	Heavy Metals + As + SOC + TOC + Cyanide	P	66-71
	Terra Mine, Area Samples	4	Heavy Metals + As + SOC + TOC + Silver	P	70-71
	Echo Bay Mine, Area Samples	5	Heavy Metals + As + SOC + TOC + Silver	P	69-71

*TIC/TOC 1971-72 Only

Table 8.3.4. Northwest Territories (Cont.)

Basin / Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Anderson River Basin				
10NC National Network Station	1	A + Heavy Metals + TIC/TOC*	P	69-
Coppermine River Basin				
10PC National Network Station	1	A + Heavy Metals + TIC/TOC*	P	67-
Tree River Basin				
10QA National Network Station	1	A + Heavy Metals + TIC/TOC*	P	69-
Victoria Island				
10TA National Network Station	1	A + Heavy Metals + TIC/TOC*	P	69-
Ellice River Basin				
10QD National Network Station	1	A + Heavy Metals + TIC/TOC*	P	69-
Back River Basin				
10RC National Network Station	1	A	P	69-
Chesterfield Inlet (Baker Lake Basin)				
6JC-6MB National Network Stations	9	A	P	69-

* TIC/TOC 1971-72 Only

Table 8.3-4. Nova Scotia

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Northern Mainland					
1DA-1DS	National Network Stations	10	A + Heavy Metals	M	69-70
	National Network Stations	23	A + Heavy Metals + Cd	M	71-
	Water Quality Survey	54	Hg + Cd	P	71-
	Municipal Water Survey	5	A + Heavy Metals + Cd	P	71
	Amherst Water Commission	8	A + Heavy Metals + Cd	P	72
	Department of Public Works	2	A + Heavy Metals + Cd	P	72
	Fraser Brook Research Basin	8	A + Heavy Metals + Cd*	M	67-
	Sharpe Brook Research Basin	4	A + Heavy Metals + Cd*	M	67-
	Groundwater Study	18	A + Heavy Metals + Cd	SM	72-
Southern Mainland					
1EA-1ER	National Network Stations	9	A + Heavy Metals	M	69-70
	National Network Stations	20	A + Heavy Metals + Cd	M	71-
	Canadian Wildlife Service Kejimkujic National Park Survey	29	A + Heavy Metals + Cd	P	71-
	Water Quality Survey	28	Hg + Cd	P	71-
	Halifax	4	A + Heavy Metals + Cd*	P	70-71
	Yarmouth Water Supply	2	A + Heavy Metals + Cd	P	72

* Cd 1971-72 Only

Table 8.3.4. Nova Scotia (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
	Groundwater Study	15	A + Heavy Metals + Cd	BM	72-
Cape Breton Island					
1EA 1EJ	National Network Stations	2	A + Heavy Metals	M	69-70
	National Network Stations	12	A + Heavy Metals + Cd	M	71-
	Water Quality Survey	20	Hg + Cd	P	71-
	Municipal Water Survey	7	A + Heavy Metals + Cd	P	71
	Department of Environment Fisheries Service	3	A + Heavy Metals + Cd	P	72
	April Brook Research Basin	7	A + Heavy Metals + Cd*	M	67-
	Groundwater Study	8	A + Heavy Metals + Cd	BM	72-

* Cd 1971-72 Only

Table 8.3-4. Ontario

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Ottawa River Basin					
2JD-2LB	National Network Stations	14	J	M	68-
	Ottawa River Survey	7	Nutrients + Mercury	M	70-71
	Kanata Project	4	Nutrients + Coliforms	W-S	72-
	Water Quality Index	3	Heavy Metals + Nutrients + Coliforms	W-S	71
Great Lakes and St. Lawrence River Basin					
2AD-2MB	National Network Stations	22	A + TOC*	M	67-
	National Network Stations	10	J	M	68-
Winnipeg River Basin					
5PC-5QE	National Network Stations	2	A + TOC*	M	66-
	National Network Stations	2	J	M	68-
Moose River Basin					
4JD-4ME	National Network Stations	4	A + TOC*	BM	67-
Severn River Basin, Winisk River Basin and Albany River Basin					
4CA-4HA	National Network Stations	2	A + TOC*	BM	67-
	National Network Stations	3	J	M	68-

* TOC 1972 Only

Table 8.3-4. Prince Edward Island

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
1CA-1CE	National Network Stations	3	A + Heavy Metals	M	66-70
	National Network Stations	4	A + Heavy Metals + Cd	M	71-
	P.E.I. Water Authority	31	Various	P	71
	P.E.I. W.Q. Survey	71	Pesticides + Cd + Hg	P	71
	C.F.B. Summerside	4	A + Heavy Metals + Cd + Lead + Phenolic Material	P	71-72
	P.E.I. Environmental Control Commission	22	A + Heavy Metals + Cd + Hg + Pesticides	W S	72-
	Groundwater Survey	20	A + Heavy Metals + Cd	BM	72-

Table 8.3-4. Quebec

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Ottawa River Basin					
2KC-2LH	National Network Stations	3	A + Nutrients	BM	72-
	Gatineau Park Study 1970-71	50	Nutrients	W-S	70-71
	Gatineau Park Study, (University of Ottawa), 1971	16	A + Nutrients	P	71
	Gatineau Park Study 1972	12	Nutrients	W-S	72
	Gatineau Park Pinks Lake Study (University of Ottawa) 1972	1	Nutrients	W-M	72-
St. Lawrence River Basin					
2MC-2PK	National Network Stations	22	A + Nutrients*	M	69-71
	National Network Stations	39	A + Nutrients*	M	72
	St. Lawrence River Study	36	Heavy Metals + TOC + Pesticides + Trace Organics	M	72-
	Quebec Field Trip 1970	5	A + Nutrients	P	70

*TIC/TOC, Nutrients, 1971-72 Only

Table 8.3 4. Saskatchewan

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Saskatchewan River Basin					
5EG-5HH	National Network Stations	7	A + Heavy Metals* + TOC*	M	66-
	Saskatchewan River Basin Study	10	A + Heavy Metals* + Nutrients	M	68-
	Switf Current Basin	5	A + DO/BOD + Nutrients	D-P	71-72
	Mercury Survey 1970	10	Hg	P	70
	Trace Metals Survey Sask.	16	A + Trace Metals + Pesticides + As + TOC + Cyanide	P	71-
Qu'Appelle Basin					
5JE 5JM	National Network Stations	6	A + Heavy Metals* + TOC*	M	66-
	Qu'Appelle and Assiniboine River Basin Study	12	A + Heavy Metals + Nutrients	M	68-
	Qu'Appelle Basin Study	66	A + DO/BOD + Nutrients + TOC + TIC	W-S	70-72
	Moose Jaw River Study	20	Nutrients + Heavy Metals + Cd	D-M	72-
	Qu'Appelle Basin Study (Groundwater)	51	Heavy Metals + Hg + Cd + Strontium	P	71
	Trace Metals Survey Sask.	25	A + Trace Metals + Pesticides + As + TOC + Cyanide	P	71-

* Heavy Metals, TIC/TOC, 1972 Only

Table 8.3-4. Saskatchewan (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Assiniboine River Basin					
5MB-5ME	National Network Stations	3	A + Heavy Metals* + TOC*	M	66-
	Qu'Appelle and Assiniboine River Basin Study	4	A + Heavy Metals* + Nutrients	M	68-
	Qu'Appelle Basin Study (Groundwater)	34	Heavy Metals + Hg + Cd + TOC/TIC + Strontium	P	71
	Trace Metals Survey Sask.	3	A + Trace Metals, Pesticides + As + TOC + Cyanide	P	71-
	Potash Study 1971	1	A + Heavy Metals + Nutrients + DO/BOD	P	71
Souris River Basin					
5NA-5ND	National Network Stations	4	A + Heavy Metals* + TOC*	M	60-
	Qu'Appelle & Assiniboine River Basin Study	2	A + Heavy Metals* + Nutrients	M	68-
	Qu'Appelle Basin Study (Groundwater)	3	Heavy Metals + Hg + Cd + TOC/TIC + Strontium	P	71
	Trace Metals Survey Sask.	1	A + Trace Metals + Pesticides + As + TOC + Cyanide	M	71
Carrot River Basin					
5KB-5KC	National Network Stations	2	A + Heavy Metals* + TOC*	M	66-

*Heavy Metals, TIC/TOC, 1972 Only

Table 8.3-4. Saskatchewan (Cont.)

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Red Deer River Basin					
5LC	National Network Stations	1	A + TOC*	M	66-
	Trace Metals Survey Sask.	1	A + Trace Metals + Pesticides + As + TOC + Cyanide	P	71-
Frenchman River Basin					
11AC	National Network Station	1	A + Heavy Metals* + TIC/TOC*	M	60
	Trace Metals Survey Sask.	1	A + Trace Metals + Pesticides + As + TOC + Cyanide	P	71-
Churchill River Basin					
6AG-6EA	National Network Stations	9	A + Heavy Metals + TIC/TOC	M	71
	Beaver River Specials	3	A + Heavy Metals	P	70
Old Wives Lake Basin					
5JA-5JB	National Network Stations	3	A + Heavy Metals* + TIC/TOC*	M	60-
	Trace Metals Survey Sask.	1	A + Trace Metals + Pesticides + As + TOC + Cyanide	P	71-
Lake Athabasca Basin					
7LA-7MB	National Network Stations	6	A + TOC*	P	70-

* Heavy Metals, TIC/TOC, 1972 Only

Table 8.3-4. Yukon Territory

Basin	Project	No. of Stns.	Parameters Measured	Sampling Freq.	Period of Record
Yukon River Basin					
9AA-9FD	National Network Stations	16	A + Heavy Metals + TIC/TOC*	P	67-
	Anvil Mine, Area Samples	5	Heavy Metals + TOC + SOC + Cyanide	P	69-71
	Venus Mine, Area Samples	2	Heavy Metals + TOC + SOC + As + Silver + Cyanide	P	70-71
	Arctic Gold and Silver Mine, Area Samples	1	Heavy Metals + TOC + SOC + Silver	P	70
	New Imperial Mine, Area Samples	6	Heavy Metals + TOC + SOC	P	69-71
	United Keno Hill Mine, Area Samples	7	Heavy Metals + TOC + SOC + As	P	69-71
Liard River Basin					
10AA-10AB	National Network Stations	2	A + Heavy Metals + TIC/TOC*	P	69-
	Mackenzie River Project	1	A + TIC/TOC + Trace Metals	P	69
Peel River Basin					
10MA	National Network Station	1	A + Heavy Metals + TIC/TOC*	P	69-71

* TIC/TOC 1971-72 Only

9.0 Sediment (Sediment System)

9.1 Sediment Survey Programs

Systematic surveys of the sediments transported by streams have been undertaken by the Sediment Survey Section of the Applied Hydrology Division since 1961. There were 149 sediment stations operating in 1972. Limited surveys and investigations were carried out before 1961 by individual organizations or agencies.

Stations where sediment data are collected are at present identified in the Surface Water Data Reference Index (also see Table 9.1-1).

The sediment survey program of data collection has four main objectives:

(1) to collect and publish long-term basic sediment records on streams throughout Canada,

(2) to determine the relationship between sediment transport and various aspects of hydrology and geomorphology,

(3) to complement the hydrometric survey program,

(4) to standardize and improve equipment and techniques for sediment survey work.

In addition to its regular sediment data collection program, the Sediment Survey Section undertakes a large program of special morphological surveys, investigations and studies which cover reservoirs, lakes, watersheds, deltas and estuaries, as well as river channels. This work is performed at the request of the provinces or other federal departments. Some 25 projects have been undertaken and some reports on them are available (see "Publications").

The Sediment Survey Section's program covers also the research work applicable to field survey conditions, including the development of techniques and equipment for different rivers and flow conditions. The results of such studies appear in separate reports (1).

9.2 Procedures

The basic sediment data are collected by the district offices of Water

Table 9.1-1 Sediment Stations by District

District Code	District	Area Covered	Existing Stations*
2	Vancouver	British Columbia	25
3	Calgary	Alberta	35
8	Regina	Saskatchewan	11
4	Winnipeg	Manitoba	28
5	Guelph	Ontario	14
6	Montreal	Quebec	2
7	Halifax	(New Brunswick	7
		(Nova Scotia	7
		(Prince Edward Island	4
		(Newfoundland	1
3	Vancouver	(Northwest Territories	12
2	& Calgary	(Yukon Territory	3
		TOTAL	149

* Stations are identified by eight-digit codes, the first digit is the district code number and the remaining seven digits give the station number, e.g.:
Vancouver district - 208DA006
Guelph district - 502FF002

Survey of Canada at Vancouver, Calgary, Regina, Winnipeg, Raleigh, Halifax and the Montreal area, under the technical supervision of the Sediment Survey Section at headquarters (including the programming of each station). The data are then compiled, reduced and published in Ottawa.

The sediment sampling for the data collection program consists of the following elements:

(i) periodic measurement of suspended sediment discharge by the depth-integrating or other method,

(ii) limited measurement of suspended sediment discharge by the point-integrating method,

(iii) individual suspended sediment samples at a selected vertical, or by continuous or periodic automatic samples at selected points,

(iv) periodic measurement of bed load discharge (by various methods),

(v) periodic sampling of bed material in cross-section.

The main part of the sediment data tabulations is devoted to survey stations, drainage areas, station locations, streamflow and sediment discharge records, types of sampling, periods of operation, magnetic taping of data, and notes on special conditions at stations or any special data provided by them.

Sediment sampling is being carried out at or near existing hydrometric stations, and the same station identification is being used in both cases.

Tabulations also indicate the latest available drainage area for each station, in square miles, and the location of the station by latitude and longitude.

Suspended sediment discharge records show the years for which discharge data are available. Daily sediment observations indicate whether the regular daily samplings of sediment were performed by continuous or periodic automatic sediment samplers or recorders, or were taken by an observer using the depth-integrated method at a selected vertical, which is representative, but often not the average, of the sediment concentration in the cross-section.

9.3 Availability

The results of the sediment surveys are published by Water Survey of Canada in the annual "Sediment Data for Canadian Rivers" series, which is currently available for the years 1965 to 1968. Figure 9.3.1 shows a sample page from that publication.

FRASER RIVER AT MISSION CITY - STATION No. 8MH-24

Location: Lat. 49° 07' 39", long. 122° 18' 08", British Columbia, on north bank, fifty feet west of the Canadian Pacific Railway bridge.
Gauge: Recording and telemetering; datum of gauge is 0.24 foot above Geodetic Survey of Canada datum, Publication 24-A (1961).
Period of Record: Elevations only, maximum yearly, 1876, 1882 and 1894 to 1935; daily maximum and minimum, mainly continuous, August 1935 to September 1967. Miscellaneous measurements in 1964 and daily discharges, May 1965 to September 1967. Daily suspended sediment load, May 1965 to September 1967.
Extremes Recorded: Maximum instantaneous discharge, 485,000 cfs at 9.45 a.m. on June 22, 1967.
Minimum daily discharge, 33,100 cfs on March 4, 1960.
Maximum daily elevation, 25.75 feet on June 5, 1894.
Minimum daily elevation, usually reaches a gauge height of -1.00 foot.
Add 0.24 to obtain elevation in feet, Geodetic Survey of Canada datum, Publication 24-A (1961).
Maximum daily suspended sediment load, 781,000 tons/day on June 7, 1967.
Minimum daily suspended sediment load, 471 tons/day on March 2, 1966.
Remarks: The river at this station is affected by tides to varying degrees at all stages. Daily mean discharges greater than 190,000 cfs (gauge height 10.00 feet) were determined from a stage-discharge relationship. Daily mean discharges for gauge height of 10.00 feet and less were calculated by summing (a) the flow of the Fraser River at Hope (with 24 hours time lag), (b) 146 per cent of the flow of Harrison River near Harrison Hot Springs and, (c) ± change in storage between Mission City and Sumas River at Sardis. Flow records fair except during periods when flows are less than 190,000 cfs which are poor. Suspended sediment records poor.

Monthly Mean Suspended Sediment Load in Tons per Day

Year	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Mean
1965									260,000	89,500	44,600	19,000	103,000
1966	32,000	11,600	3,060	2,200	929	2,910	55,200	235,000	219,000	117,000	51,200	14,000	62,300
1967	13,400	5,300	10,600	2,310	1,090	1,740	16,900	263,000	579,000	158,000	38,200	14,000	92,000

Suspended Sediment for the 1967 Water Year

	October				November				December			
			Suspended Sediment				Suspended Sediment				Suspended Sediment	
Day	Water Temp. (°F)	Daily Discharge (cfs)	Mean Concentration (gr/litre)	Tons per day	Water Temp. (°F)	Daily Discharge (cfs)	Mean Concentration (gr/litre)	Tons per day	Water Temp. (°F)	Daily Discharge (cfs)	Mean Concentration (gr/litre)	Tons per day
1		103,000	0.039	10,800	45	113,000	0.042s	12,800		71,700	0.018	3,480
2		110,000	0.060	17,800		108,000	0.035	10,200	37	67,300	0.015s	2,730
3	55	114,000	0.075s	23,100		104,000	0.029	8,140		64,200	0.014	2,430
4		114,000	0.075	23,100	44	100,000	0.024s	6,480		61,800	0.013	2,170
5		112,000	0.075	22,700		95,500	0.024	6,190	39	62,700	0.011s	1,860
6	55	110,000	0.075s	22,300		93,700	0.023	5,820		62,700	0.010	1,690
7		107,000	0.070	20,200		90,900	0.021	5,150		64,500	0.010	1,740
8	53	105,000	0.060	17,000	42	90,800	0.020s	4,900		62,200	0.010	1,680
9		102,000	0.047	12,900		89,700	0.020	4,840	37	56,500	0.010s	1,530
10		101,000	0.043	11,700		86,800	0.021	4,920		51,600	0.010	1,390
11		104,000	0.045	12,600		80,000	0.022	4,750		50,700	0.011	1,510
12	51	105,000	0.049s	13,900	39	74,600	0.024s	4,830		58,000	0.014	2,190
13		104,000	0.048	13,500		70,600	0.026	4,960	44	73,300	0.027s	5,340
14		99,700	0.043	11,600		71,300	0.030	5,780		97,600	0.039	10,300
15		97,200	0.036	9,450		73,500	0.034	6,750		94,700	0.070	17,900
16		92,600	0.030	7,500	40	72,300	0.023s	4,490	42	107,000	0.095s	27,400
17	49	89,200	0.026s	6,260		69,700	0.017	3,200		120,000	0.105	34,000
18		85,900	0.025	5,800		65,700	0.015	2,660		210,000	0.120	68,000
19	47	83,400	0.027s	6,080	41	61,300	0.015s	2,480	41	133,000	0.120s	43,100
20		85,400	0.038	8,760		62,500	0.015	2,530	40	128,000	0.085s	29,400
21		84,800	0.037	8,470		62,900	0.015	2,550	40	119,000	0.060s	19,300
22		81,500	0.033	7,260		64,700	0.015	2,620		113,000	0.045	13,700
23		80,000	0.049	10,600	40	65,500	0.016s	2,830	38	107,000	0.028s	8,090
24	48	93,400	0.090s	22,700		63,900	0.018	3,110		103,000	0.020	5,560
25		97,300	0.060	15,800		63,200	0.038	6,480		97,300	0.017	4,470
26	48	96,600	0.027s	7,040	39	68,000	0.036s	6,610	38	90,800	0.013s	3,190
27		104,000	0.025	7,020		64,100	0.029	5,020		84,600	0.013	2,970
28		111,000	0.029	8,690		67,300	0.033	6,000		80,400	0.013	2,820
29		115,000	0.040	12,400		73,900	0.040	7,980		75,600	0.013	2,650
30	47	120,000	0.060s	19,400	37	74,400	0.022s	4,420	38	74,000	0.013s	2,600
31		118,000	0.055	17,500		-	-	-		71,200	0.013	2,500
Total		3,126,000	1.491	413,930		2,341,800	0.742	173,490		2,713,40	1.55	367,09
Mean		101,000	0.048	13,400		78,100	0.025	5,300		87,500	0.034	10,600

s - Sample(s) collected this day.

Figure 9.3-1. Sample page from "Sediment Data for Canadian Rivers."

Data collected for the 1964 water year and earlier have been issued in the Water Resources Papers series.

Publications are available from Information Canada, from the Publications Office, Inland Waters Directorate, or the Director, Water Resources Branch, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario, or from the District Offices at Vancouver, Calgary, Regina, Winnipeg, Guelph and Halifax, or the Area Office at Montreal (see "Addresses").

9.4 Users

The current distribution of "Sediment Data for Canadian Rivers" amounts to some 700 copies. The Canadian users of the sediment information include libraries, federal agencies, universities, provincial agencies, civic offices, consultants and private organizations. The distribution in other countries goes principally to the United States, and also to Argentina, Australia, England, France, Germany, India, New Zealand, Poland, Rumania, the U.S.S.R. and Sweden.

9.5 Plans

The number of sediment survey stations will be increased to 300 or 400 in the next 10 to 15 years.

The establishment of a separate sediment data reference index is planned for the near future.

9.6 References

1. Stichling, W., *Instrumentation and Techniques in Sediment Surveying*. Inland Waters Branch Reprint Series, No. 22, Department of Energy, Mines and Resources, 1970.

   Stichling, W., and T.F. Smith, *Sediment Surveys in Canada*. Inland Waters Branch Technical Bulletin No. 12, Department of Energy, Mines and Resources, 1969.

   Tywoniuk, N., and J.L. Fowler, *Winter Measurements of Suspended Sediments*. International Symposium on the Role of Snow and Ice in Hydrology, 1972.

   Tywoniuk, N., *Sediment Budget of the Lower Fraser River (Estuary)*. Paper prepared for presentation at the 13th International Conference on Coastal Engineering, Vancouver, 1972.

10.0 Use of Water Resources (WATERSTAT System)

10.1 Water, Administrative, Technical and Economic Resources Statistics (WATERSTAT)

WATERSTAT is a general purpose computerized storage, retrieval and manipulative system for numerical data related to water resources research, planning and management. It is also a convenient vehicle for retrieval and manipulation of data stored in other important national statistical data banks, such as Census Data of Statistics Canada, or the Canadian Geographic Information System (1). Through WATERSTAT, data of many different sources and levels of quality can be used in concert with planning data generated in Environment Canada.

The collection of data for WATERSTAT began in 1970 with municipal water use and related population data for Canadian municipalities. A more comprehensive project was started in 1972 for collecting population and industrial data related to water use in the Grand River watershed. A start was also made in 1972 with entering population, visitors' survey, fishing survey and residents' survey data related to the use of the water resource in the Okanagan River Basin. Another project begun in the fall of 1972 was the collection of data in the James Bay area.

The numeric data base, or set of data bases, for WATERSTAT contains the following information:

(i) water use (industrial and municipal),

(ii) water supply,

(iii) water pricing,

(iv) the capacities of water supply and water treatment plants,

(v) sewage systems,

(vi) the financial aspects of water supply and demand,

(vii) population and other socio-economic data on production, incomes, expenditures and recreational use of water resources,

(viii) the quantitative results of perception and attitude studies on resources management.

WATERSTAT is used in concert with the square grid storage and retrieval system (see Hydrologic Square Grid Data System in "Physiographic Data" section of ... as well as the Canadian Geographic Data System and the GEOCODING ... CRDSR system [311] (CRDSR is Geographically Referenced Data Storage and Retrieval)

The above method has unique capabilities for aggregating and combining data from a variety of sources, because it provides the tools to make various data bases compatible, and hence opportunities for the easy exchange and simultaneous use of elements from various data bases. The storage and retrieval system can disseminate data at various levels of aggregation to produce tables and maps, or to provide direct input to mathematical models.

Data are collected through exchange agreements with other agencies, through departmental studies and studies made under the Canada Water Act, through agreements with provincial agencies and universities, and through contracts with private consultants.

The WATERSTAT data bases will be linked eventually with the Water Resources Document Reference Centre, called WATDOC (see pages 88-99). This will provide full source documentation and access to background material.

10.2 Procedures

Data existing in other large data bases, such as the GEOCODING system, will not be stored in the WATERSTAT system. Whenever required, the data is automatically converted into the required format through the system programs.

If desired, data can be made available in printed form. Most requests will be satisfied by the following formats:

(i) maps (produced by line-printer) in areal aggregations requested by the user (see Figure 10.2-1),

(ii) tables of cross-referenced parameters (see Figures 10.2-2 and 10.2-3),

(iii) punched card output,

(iv) magnetic tape output.

A strong feature of WATERSTAT is its capability to be linked directly with many manipulative program packages, such as MASSAGER (4), which is generally employed in the fields of economics, econometrics and statistics. Because of these packages, WATERSTAT can be used successfully in modelling exercises.

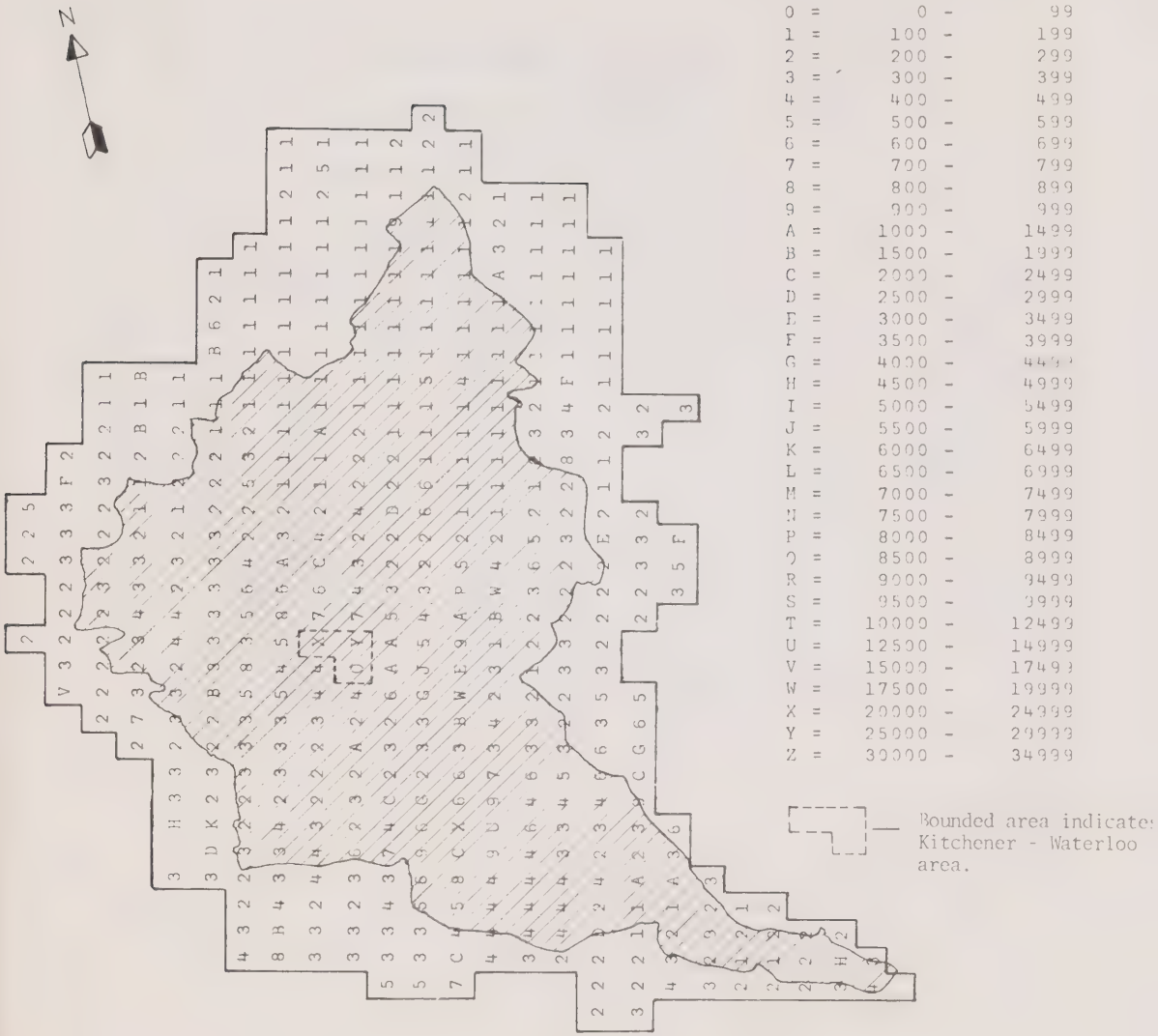


Figure 10.2-1 Sample of computer-generated map.

OKANAGAN RIVER BASIN

VISITOR'S SURVEY 1970

OUTDOOR RECREATION

Activity	Adults only	Children only	Total
Swimming	50	100	150
Boating (inc. canoeing)	60	120	180
Sailing	32	48	80
Fishing	62	81	143
Water Skiing	30	45	75
Underwater swimming	29	2	31
Hunting	40	3	43
Hiking	24	92	116
Observing Wildlife	33	51	84
Camping	68	126	194
Skiing	84	41	125
Skating	49	120	169
Tennis	58	23	81
Golf	110	5	115
Horse riding	58	68	126
Cycling	28	100	128
Organized sports	41	84	125
Walking	27	40	67
Driving for pleasure	110	0	110

Figure 10.2-2 Sample of computer-generated table

CANADIAN MUNICIPAL WATER UTILITIES DATABASE

PART 1. MUNICIPAL WATER SUPPLY SYSTEMS

KINGSTON ONT. 3510111 5131 2MA 0 1 1 1 1

Year	Pop. Served (thousands)	Water Cons. (thous. gal. /day)	No. of Services	No. of dom. outlets
1961	48.4	8000.	11343.	10040.
1962	48.4	8000.	11454.	10032.
1963	48.4	8200.	11733.	10293.
1964	48.4	8590.	12094.	10625.
1965	56.3	8282.	12196.	10732.
1966	66.0	8500.	12500.	-0.
1967	70.0	8700.	12530.	-0.
1968	64.0	9000.	12663.	-0.

Figure 10.2-3 Sample of computer-generated table

10.3 Availability

Data on the use of water resources are available on request for regional areas in the following categories:

a) Population

1951, 1956, 1961 and 1966, and projected values by square grid; Southern Ontario and Grand River watershed.

b) Current Industrial Data

Southern Ontario.

c) Municipal Water Use

1961-70.

d) Surveys

1970 residents', fishing and visitors' surveys; Okanagan River Basin.

Selected data are currently available to users from Water Resources Data Systems, Inland Waters Directorate, Environment Canada, Ottawa, K1A 0E7, Ontario. (Telephone 819-997-2329).

The data programs are compiled and stored in the Resources Data Systems library on direct access disc. The data files are also stored on disc to facilitate retrieval. Any requests for data should specify the area, time period and level of aggregation required by the user.

10.4 Plans

WATERSTAT in its present form has been introduced only recently. The work is now focused on the improvement of the automated linkage features in relation to other systems, and also on the accumulation, collection and entry of data that are produced in Environment Canada.

Future developments in service will be directed to the establishment of co-operative arrangements with other agencies and research centres that produce relevant data.

Technical developments will be concentrated in future on the establishment of on-line interactive communication for the users and the WATERSTAT system, and also on applications of simulation modelling.

10.5 References

1. Lands Directorate, *Canadian Geographic Information System*. Lands, Forests and Wildlife Service, Environment Canada, Ottawa (unpublished).

2. Shawinigan Engineering Company Limited, *Hydrometric Network Study for Western and Northern Canada*. November, 1970. (Other related studies similarly describe the Hydrologic Square Grid Data System).

3. Statistics Canada, Geocoding: *Geographically Referenced Data Storage and Retrieval System (GRDSR)*. Census User Enquiry Service, Census Division, Statistics Canada, Department of Industry, Trade and Commerce, Ottawa.

4. McCracken, M.C., *Databank System, MASSAGER/70*. Bank of Canada Users' Manual. Ottawa.

11.0 Planning and Management, Scientific Documentation (WATDOC System)

11.1 Water Resources Data Systems Document Reference Centre (WATDOC)

WATDOC is an information project undertaken by the Inland Waters Directorate of Environment Canada (1). Its purpose is to increase the exchange of knowledge on all aspects of research, planning and management of Canadian water resources. The project provides a centralized source of bibliographic references to published and unpublished reports, studies, analyses, research activities, matters of public interest and newspaper reports.

A group of participating agencies and university research centres will co-operate in this information system on the basis of a simple barter arrangement. This means that the users will have access to a large computer data base on condition that they, in turn, contribute to the maintenance and expansion of the base by providing bibliographies and abstracts of references in their fields of specialty.

As part of this system, a set of sophisticated computer programs, developed and operated by the QUIC LAW Project (2) at Queen's University, is available to the user for carrying out literature searches in a conversational mode. By this means, on-line interactive cathode ray terminals produce instant response to queries in plain English. In addition, batch mode searches (the University of Alberta's batch retrieval programs (3)) permit the screening of massive files through various levels of boolean logic.

The strength and usefulness of WATDOC will depend mainly on the ability to keep the data base comprehensive and up-to-date. Environment Canada is acquiring information tapes from agencies in the U.S.A., but the essential Canadian input for the Reference Centre will come from the participating agencies, institutions, and individuals in Canada's water resources community, and from Canadian newspapers.

The data base is designed to enable each participant to consider it as his own stock of information. Although the bibliographical notes are entered on a standard form (see Appendix 11.6-1), the information can always be identified by the name of the person or agency that supplied the bibliography.

11.2 Procedures

The practical procedure for entering documents into WATDOC is simple. Participants are provided with coding forms (Appendix 11.6-1) and

a brief instruction manual. Before the user starts to code whatever documents he may have encountered, a call to the WATDOC operator will suffice to avoid coding documents that are already stored in the system. Those documents not in the system are then coded. After coding, the completed forms are sent to the WATDOC Centre for editing and conversion into machine readable form. The coded documents are then entered into the centralized data base. The steps in the input procedure are outlined in Appendix 11.6-2. Participants will receive computer printouts of all the references provided by them. Upon request, the participant can also be supplied with individual author and/or keyword indexes of all the material he has submitted. Samples of the index are shown in Appendix 11.6-3 and 11.6-4.

The users of WATDOC have a choice between two methods of communication. These are:

(i) To rent an IBM 3275 CRT (cathode ray tube) terminal and communication facilities. This is the more direct way of communicating with the data base, which is accessible for 14 hours each working day (see Appendix 11.6-5). An image of the display screen for an individual reference is given in Appendix 11.6-6.

(ii) To use toll-free telephone connections. In this case, the operator at the Centre provides the interface with the terminal. The caller gives some key words, and the operator, after consulting the data base, makes suggestions for additional key words, or key word modifications. After agreement on this matter, the search is made immediately, and the operator reads the results (see Appendix 11.6-7). This is an inexpensive, but less direct, form of communication.

In both cases, the caller may order printouts of the selected bibliographies and abstracts.

11.3 Availability

From one terminal or telephone, the participant has access to full text and bibliographic data bases of Environment Canada, Department of Justice, and the National Research Council/National Science Library (see Appendix 11.6-8) which have the following data holdings:

Environment Canada:

- all departmental publications,
- all unpublished reports,

- research under federal grants,

- new items in Canadian newspapers on water pollution and other matters of public interest,

- documents entered by participating university research centres,

- U.S.A. water resources scientific information.

Department of Justice:

- Canada Supreme Court decisions,

- Federal Statutes,

- Provincial Statutes.

National Research Council/National Science Library:

- all document references pertaining to pollution (water, air, thermal, noise, etc.) selected from world literature.

The cost to participants in WATDOC is minimal; no charges are made for input and storage. Those who choose to rent a terminal will have to meet that charge. The participants receive credits for coding, abstracting and preparing references to relevant documents for input to the data base.

Non-participants may use the Centre's services at charges which reflect only part of the cost of maintaining an up-to-date stock of document references.

Enquiries should be directed to Water Resources Data Systems. (Telephone 819-997-2324; for literature searches telephone collect - 819-997-1238).

The minimum contribution of each participant to the data base will obviously vary with the size of the participant's organization. The target level for each is established through guidelines formulated by the Users' Committee. This committee is comprised of representatives of the participating users.

11.4 Plans

WATDOC is at present operating with terminals in Ottawa, Hull and Toronto. Short-term plans call for the expansion of the network to include a number of regional offices of Environment Canada and university research centres across Canada.

Prime efforts will be directed continually towards increasing the level

of completeness. The system is also storing information on research in progress.

Another feature that is being developed for users is an automated Selective Dissemination Service, using individualized user profiles. This service would be complementary to the National Research Council/National Science Libarary's CAN/SDI service.

11.5 References

1. Batteke, J.P.H., *An Information System for Water Resources Management: The Co-operative Approach*. A Departmental Management Briefing, Environment Canada, Ottawa, 1972.

   Batteke, J.P.H., and M.A. Mercier, *A National Water Resources Scientific Information System: Design Criteria and Implementation*. Reprint from American Society for Information Service, Western Canada Chapter, Fourth Annual Meeting, Winnipeg, 1972, available from Water Resources Data Systems.

2. QUIC/LAW Project 1971, *The QUIC/LAW Information Retrieval System*, unpublished. Queen's University, Kingston.

3. Thiel, L.H., and H.S. Heaps, *Program Design for Retrospective Searches on Large Data Bases*. "Information Storage and Retrieval", V. 8, pp. 1-20, 1972.

11.6 Appendix

The figures on the following pages are referred to in the preceding text.

RESOURCE DOCUMENT INFORMATION SYSTEM

005698

FRITZ P., KROUSE HR

THERMAL POLLUTION AND WATER BALANCE OF WABAMUN LAKE- AN ISOTOPIC INVESTIGATION

UNIVERSITY OF WATERLOO, UNIVERSITY OF CALGARY
EOS TRANSACTIONS AMERICAN GEOPHYSICAL UNION
·053·004·378 E

TI 11 AMOUNT 12 CONTRACT NO

AMERICAN GEOPHYSICAL UNION

·RICHMOND, VIRGINIA·0472

NOTES 16 PUBLICATION NO 17 PLACE 18 DATE

WATER MANAGEMENT LIBRARY

20 REFERENCE FILE NUMBER 21 UDC CLASSIFICATION

0001·0048 ·0503·0306·0343·

THERMAL POLLUTION, POWER, WATER POLLUTION, SURVEY METHODOLOGY

THERMAL GENERATING STATION, EVAPORATION, WATER BALANCE, WABAMUN LAKE, CENTRAL ALBERTA, CARBONATE SHELLS, MOLLUSCA

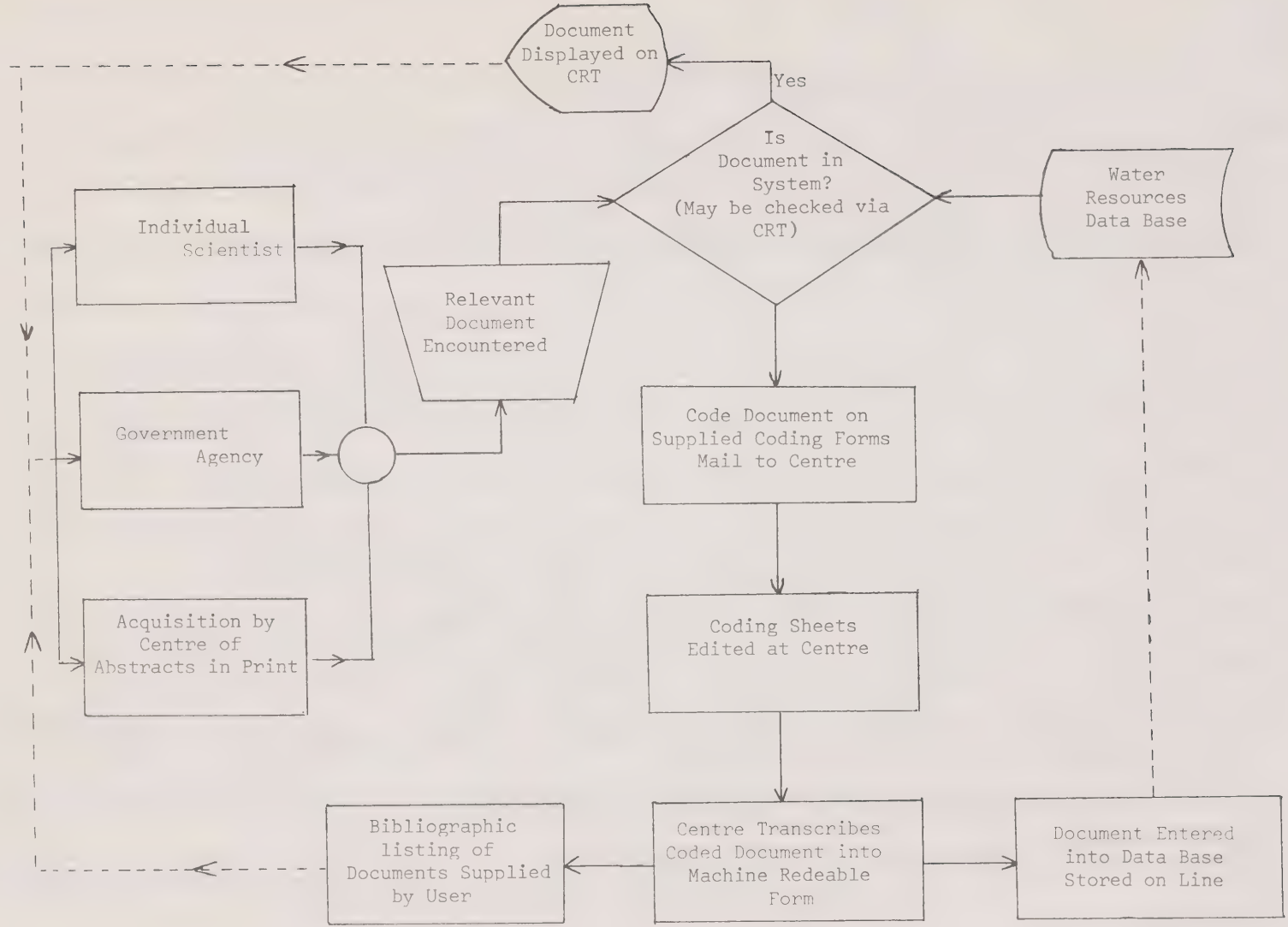
REMARKS

32 ABSTRACT

The oxygen-18 and deuterium contents of Wabamun Lake, Central Alberta, Canada indicate that this lake is strongly evaporated. This was thought to be due to the thermal pollution caused by two thermal generating stations. Since this lake was assumed to be a closed system with only [illegible] could severely affect the water balance and chemistry of the lake. [illegible] that this increased rate of evaporation should not affect the water level of Wabamun Lake but may increase its salt content.

Date OCT 3, 1972
Completed by J. Boyd

Appendix 11.6-1. Sample of a coded document.



Appendix 11.6-2. Input of documents in WATDOC.

MORTON, W F [illegible]
[illegible]*0065*PACIFIC REGIONAL UNIT*

[illegible] Y, FE 002867 TOXICITY OF CADMIUM TO ANAEROBIC DIGESTION: ITS MODIFICATION BY INORGANIC IONS*WATER POLLUTION CONTROL*70 * *594-598*E *LONDON*0071*WATER POLLUTION ABSTRACTS VOL 44*

[illegible]LEY, * 000716 ENVIRONMENTAL HEALTH STUDY PUBLIC HEALTH INSPECTORS, PROJECT 605-7-369* * *XV, 170*ENG*CANADIAN PUBLIC HEALTH ASSOCIATION*0068*GENERAL STUDIES - MCMEIKEN*

MOSS, H R 001061 BRADFORD, F W*BENEFIT-COST STUDY OF THE ANNAPOLIS-CORNWALLIS RIVER SYSTEMS*CANADIAN WOOD CHEMICAL SYMPOSIUM* * *20*ENG*0070*NACWRP FILE*

[illegible], W S 001736 OPTIMUM UTILIZATION AND MANAGEMENT OF WATER BEARING FORMATIONS HYDRAULICALLY-CONNECTED TO A STRETCH OF THE CONNECTICUT RIVER* * *21*ENG*0070*WATER SECTOR LIBRARY*

MOTZ, D J 001730 BRAMER, H C*STUDY TO DETERMINE THE COSTS OF WATER IN INDUSTRIAL USES* * *71,

[illegible], S D 000432 HARRIS, R G*PRELIMINARY REPORT ON SIMILKAMEEN IMPROVEMENT DISTRICT RECONSTRUCTION ON NICKEL PLATE DAM* * *33*ENG*B.C., DEPT OF LANDS,FORESTS AND WATER RESOURCES*0063*DREE LIBRARY - ARDA FILE*

000444 PRELIMINARY REPORT ON STORAGE SITES IN THE NORAMATA AREA (#10034-01)* * *24*ENG*BC, DEPARTMENT LANDS,FORESTS AND WATER RESOURCES*0064*DREE LIBRARY - ARDA FILE*

MOULD, S D 000434 REPORT ON ELLISON IRRIGATION DISTRICT (#10016)* * *16*ENG*BC, DEPARTMENT LANDS, FORESTS AND WATER RESOURCES*0064*DREE LIBRARY - ARDA FILE*

MOULTON, R W 001277 HENDRICKSON,H M*RESEARCH AND DEVELOPMENT OF PROCESSES FOR DESALTING WATER BY FREEZING* * *139,

MOXHAM, R M 001373 INFRARED IMAGERY AND RADIOMETRY - SUMMARY REPORT* * *29*ENG*CLEARINGHOUSE*SPRINGFIELD, VA.*0067*WATER SECTOR LIBRARY*

MT. PLEASANT RC, SCHLICKENRIEDER A 003217 IMPLICATION OF NITROGENOUS BOD IN TREATMENT PLANT DESIGN*JOURNAL SANITARY ENGINEERING DIVISION*97 *SA5*709-719*E *0071*WATER MANAGEMENT LIBRARY*

MUDRY, N 000005 FUTURE OF MANITOBA'S WATER RESOURCES*OTHER MANITOBA INSTITUTIONS* * *1[illegible]*ENG*0067*PRAIRIE REGIONAL UNIT*

[illegible]LLER F, [illegible] 003001 THE CONTRIBUTION OF GLACIER ICE TO THE WORLD WATER BALANCE*SYMPOSIUM ON WORLD WATER BALANCE*3 * *7-20*E *IASH*INLAND WATERS BRANCH REPRINT SER*102*0770*RESOURCE DATA SECTION*

MUELLER JC 002733 NUTRIENT REMOVAL BY NATURAL GAS FERMENTATION*JOURNAL WATER POLLUTION CONTROL FEDERATION*44 *1 *25-33*E *WATER POLLUTION CONTROL FEDERATION, 3900 WISCONSIN AVENUE*WASHINGTON, DC*0172*WATER SECTOR LIBRARY*

[illegible]ICH, A J 001[illegible]74 1968 NATIONAL SURVEY OF COMMUNITY SOLID WASTE PRACTICES, PRELIMINARY [illegible]

Appendix 11.6-3. Author Index as shown on display screen.

SURFACE/DATA BASE MAPPING/ICE THICKNESS* CLARKE, G K C*CANADIAN GEOGRAPHICAL JOURNAL*CANADIAN GEOGRAPHICAL JOURNAL* * *26-3?*ENG*ROYAL CDN GEOGRAPHICAL SOC.*0070*NACWRR FILE*

FLOW RESISTANCE

001072 STREAM VELOCITY/WATER PRESSURE/DENSITY CURRENTS/HEAT FLOW/HEAT TRANSFER/FLOW SEPARATION/FLUID MOVEMENT/UNIFORM FLOW/CURRENTS* CHILCOTT, R E*REVIEW OF SEPARATED AND RE-ATTACHING FLOWS WITH HEAT TRANSFER, (INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER)*INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER* * *783-797*ENG*PERGAMON PRESS LTD*GREAT BRITAIN*0067*NACWRR FILE*

FLOW SEPARATION

001072 FLUID MOVEMENT/UNIFORM FLOW/CURRENTS/FLOW RESISTANCE/STREAM VELOCITY/WATER PRESSURE/DENSITY CURRENTS/HEAT FLOW/HEAT TRANSFER* CHILCOTT, R E*REVIEW OF SEPARATED AND RE-ATTACHING FLOWS WITH HEAT TRANSFER, (INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER)*INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER* * *783-797*ENG*PERGAMON PRESS LTD*GREAT BRITAIN*0067*NACWRR FILE*

FLOW VELOCITY

002066 LAGRANGIAN CO-ORDINATES/ANALYTICAL TECHNIQUES/FLOW/POLLUTION/PARTICLE TRAJECTORIES/TIDAL WATER NUMERICAL COMPUTATIONAL TECHNIQUES/ONE DIMENSIONAL STUDY/HYDRODYNAMICAL MODELS* DEWEY, J M*CALCULATION OF THE PARTICLE TRAJECTORIES IN TIDAL FLOW* * *ENG*00 *NACWRR FILE*

FLOW

001093 CALIBRATIONS/CHEMISTRY/FLOW CHARACTERISTICS/TIME/ELECTROCHEMISTRY/FLOW MEASUREMENT/EQUATIONS/QUARTZ/VELOCITY/LIQUIDS/AQUATIC DRIFT/VISCOSITY/WATER/TURBULENCE/SPECIFIC HEAT/CONDUCTION/TURBULENT BOUNDARY LAYERS/FILMS/ANEMOMETERS/TURBULENT FLOW/DATA COLLECTIONS/ELECTRICAL EQUIPMENT* RESCH, F*HOT-FILM TURBULENCE MEASUREMENTS IN WATER FLOW (PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS)*JOURNAL OF HYDRAULICS DIVISION* * *787-800*ENG*0070*NACWRR FILE*

002053 POROUS MEDIA/GROUNDWATER/SOIL MOISTURE/LANDFILL/LEACHING* MCCORQUODALE, J A*EXPERIMENTAL AND THEORETICAL STUDY OF LEACHING FROM A LANDFILL SITE* * *ENG*00 *NACWRR FILE*

002066 POLLUTION/PARTICLE TRAJECTORIES/TIDAL WATER NUMERICAL COMPUTATIONAL TECHNIQUES/ONE DIMENSIONAL STUDY/HYDRODYNAMICAL MODELS/FLOW VELOCITY/LAGRANGIAN CO-ORDINATES/ANALYTICAL TECHNIQUES* DEWEY, J M*CALCULATION OF THE PARTICLE TRAJECTORIES IN TIDAL FLOW* * *ENG*00 *NACWRR FILE*

FLUID DYNAMICS

004203 SURFACE ACTIVE AGENTS/COALESCENCE/OIL-WATER SYSTEMS* SMITH, J W*FLUID DYNAMICS OF COALESCENCE IN OIL-WATER SYSTEMS* * *ENG*0071*NACWRR FILES*

FLUID FLOW

004198 BUBBLE DYNAMICS/AERATION/EFFLUENTS OXYGEN DEPLETION ADSORPTION* TRASS, O*FLUID FLOW AND MASS TRANSFER STUDIES RELATED TO ARTIFICAL AERATION OF RIVERS, EQUILIBRIUM DEVELOPMENT* * *ENG*0071*NACWRR FILES*

FLUID MOVEMENT

001072 UNIFORM FLOW/CURRENTS/FLOW RESISTANCE/STREAM VELOCITY/WATER PRESSURE/DENSITY CURRENTS/HEAT FLOW/HEAT TRANSFER/FLOW SEPARATION* CHILCOTT, R E*REVIEW OF SEPARATED AND RE-ATTACHING FLOWS WITH HEAT TRANSFER, (INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER)*INTERNATIONAL JOURNAL OF HEAT MASS TRANSFER* * *783-797*ENG*PERGAMON PRESS LTD*GREAT BRITAIN*0067*NACWRR FILE*

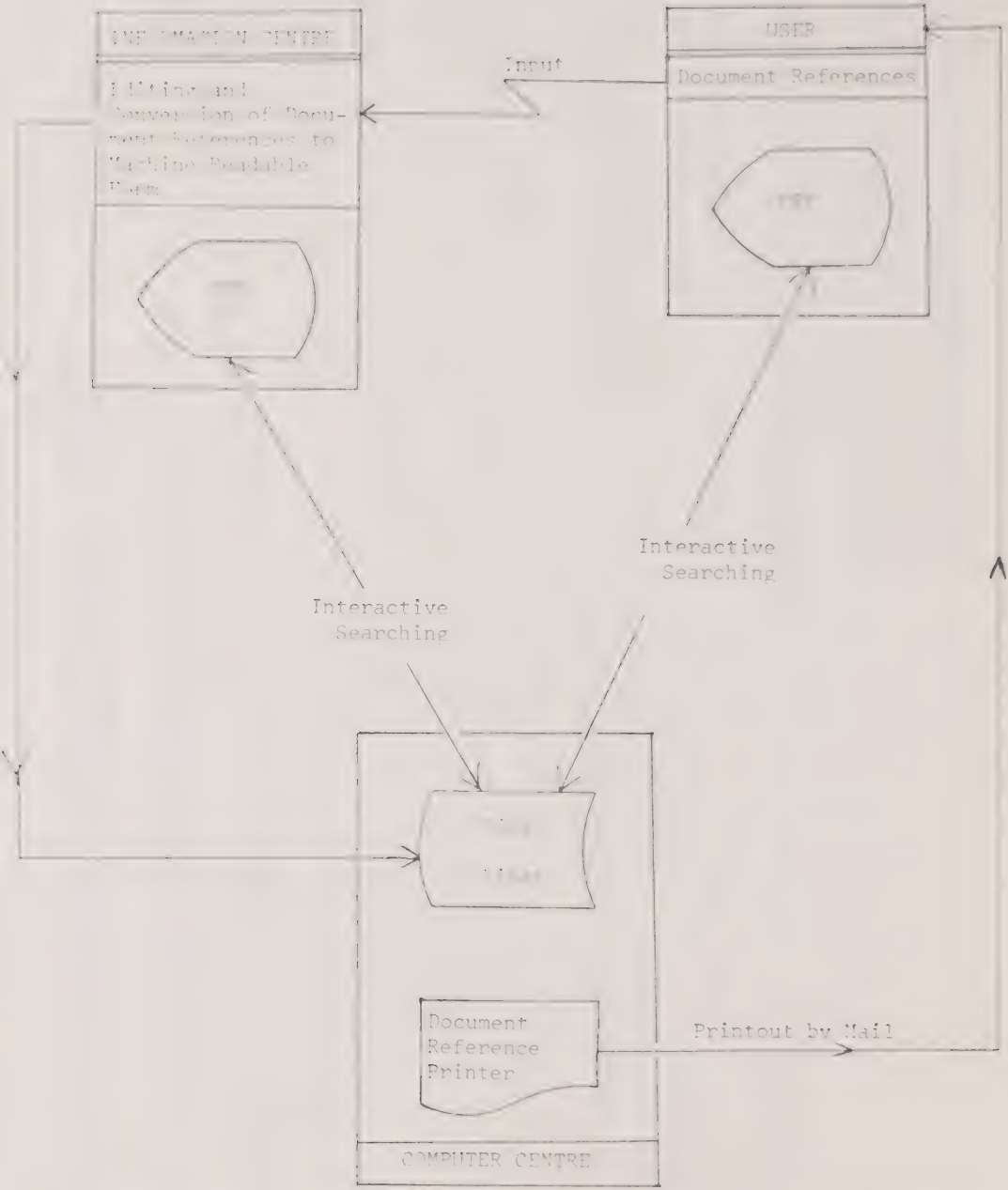
FLUID RESISTANCE

001092 PRESSURE/ANEMOMETERS/WATER FLOW/MEASUREMENT/TURBULENCE FILMS/WATER TEMPERATURE* RESCH, F; COANTIC M*ETUDE SUR LE FIL CHAUD ET LE FILM CHAUD DANS L'EAU* * *151-161 11*FRA*LA HOUILLE BLANCHE #2*0069*NACWRR FILE*

FLUIDITY

001083 GREEN ALGAE/HYDROXIDE/SOLUBILITY/STREAM FLOW/LEXICON/ABSORPTION/

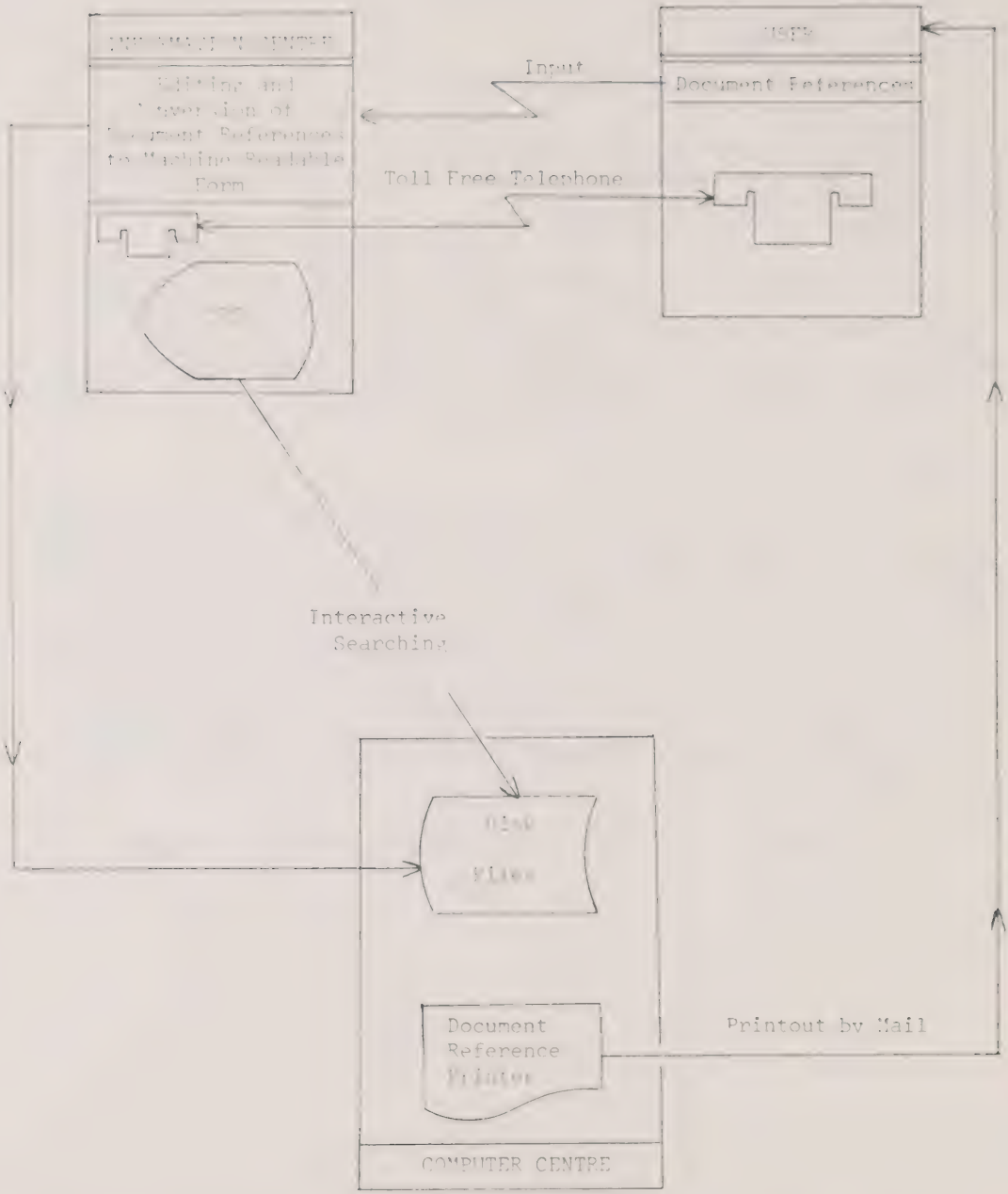
Appendix 11.6-4. Keyword Out of Context (KWOC) Index.



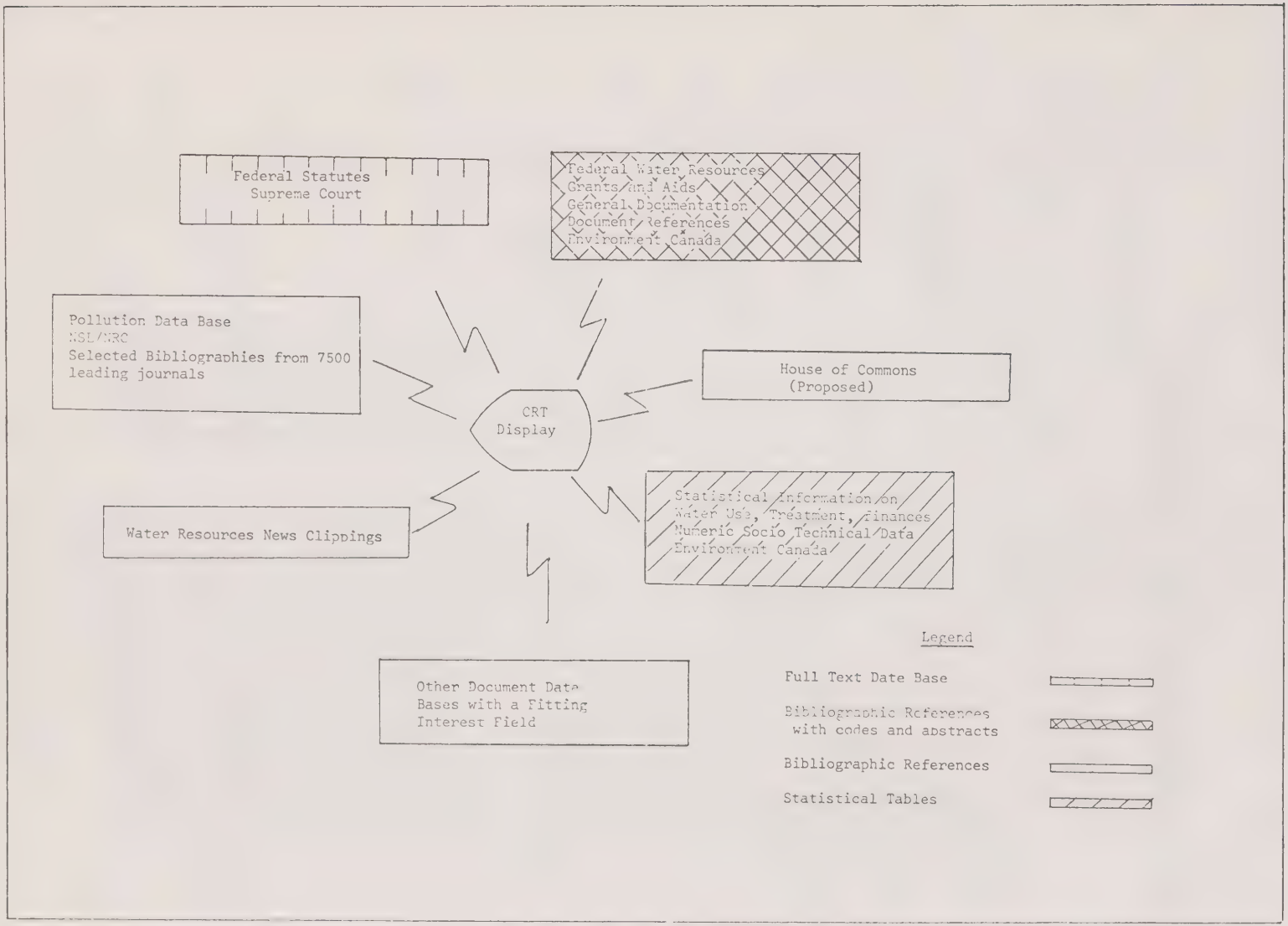
Appendix 11.6-5. Interactive searching through individual users' terminals.

3789
BRINKHURST RO
UNIVERSITY OF TORONTO, DEPARTMENT OF ZOOLOGY
DISTRIBUTION AND ABUNDANCE OF TUBIFICID (OLIGOCHAETA) SPECIES IN TORONTO HARBOUR, LAKE ONTARIO
PUBLISHER: FISHERIES RESEARCH BOARD OF CANADA
PLACE: OTTAWA DATE: 1170
JOURNAL: JOURNAL OF THE FISHERIES RESEARCH BOARD OF CANADA
VOL: 027 NO: 011 PAGES: 1961-1969
REF. SOURCE: WATER SECTOR LIBRARY
KEYWORD: OLIGOCHAETES, TORONTO HARBOUR, POLLUTION TOLERATION, VERTICAL DISTRIBUTION, SEDIMENTS, WORM POPULATION, DON RIVER, TUBIFICID (OLIGOCHAETA) SPECIES, LAKE ONTARIO
CAT: 340
GEO: 9995 35 1904
FORMAT: 25
THE TUBIFICID OLIGOCHAETES BUILD UP POPULATIONS IN EXCESS OF 200,000 SQUARE METRES IN TORONTO HARBOUR. POLLUTION-TOLERANT SPECIES IN GREAT ABUNDANCE ARE LOCATED AROUND THE MOUTH OF THE DON RIVER, WHEREAS SMALL NUMBERS AND SOME LESS TOLERANT SPECIES ARE FOUND NEAR THE ISLAND SHORES. THERE IS NO EVIDENCE OF DIURNAL RHYTHMS IN THE VERTICAL DISTRIBUTION OF THE WORMS IN THE SEDIMENT. DRY WEIGHTS FOR TUBIFICIDS ARE ABOUT 16 PER CENT OF THE WET WEIGHT FOR FRESH-STARVED WORMS. THE ASH CONTENT AVERAGED 34 PER CENT OF THE DRY WEIGHT FOR WORMS WITH A GUT FULL OF MUD, BUT 11 PER CENT FOR WORMS CLEAR OF GUT CONTENTS.
FUND: NATIONAL RESEARCH COUNCIL, DEPARTMENT OF ENERGY, MINES AND RESOURCES
TI:D

Appendix 11.6-6. Screen image display of document surrogate.



Appendix 11.6-7. Interactive searching through telephone conversation.



Appendix 11.6-8. Network of Data Bases.

12.0 Alphabetical List of Variables

	Data Base
aldrin	NAQUADAT
alkalinity	
- phenol phthalein	NAQUADAT
- total	NAQUADAT, STAR/EROS
aluminum	
- dissolved	NAQUADAT
- extractable	NAQUADAT
antimony, extractable	NAQUADAT
aquifer	
- age	GOWN
- age precision	GOWN
- final drawdown	GOWN
- interval	GOWN
- material	GOWN
- pump test rate	GOWN
- specific capacity	GOWN
- test type	GOWN
- time of test	GOWN
arsenic, dissolved	NAQUADAT
bacteria	
- aerobic viable count MF 20°C	STAR/EROS
- aerobic viable count MF 4°C	STAR/EROS
- anaerobic viable count MF 20°C	STAR/EROS
- autotrophic ammonium oxidizing	STAR/EROS
- bacterial biomass	STAR/EROS
- direct count MF/ml	STAR/EROS
- proteus, filtered/100 ml	STAR/EROS
- proteus MPN	STAR/EROS
- pseudomonas species MF	STAR/EROS
barium, extractable	NAQUADAT
barrier height of grid square	HYDROLOGIC
bed load	
- density	SEDIMENT
- discharge	SEDIMENT
- particle size distribution	SEDIMENT

	Data Base
bed material	
- density	SEDIMENT
- particle size distribution	SEDIMENT
BHC (benzene hexachloride)	NAQUADAT
bicarbonate	NAQUADAT, STAR/EROS
BOD (biochemical oxygen demand)	NAQUADAT, STAR/EROS
- probe	STAR/EROS
bog and swamp, area within grid square	HYDROLOGIC
bore hole	
- location, geographic	GOWN
- location, local	GOWN
- location, utm	GOWN
- originator	GOWN
- purpose of	GOWN
- user identification no.	GOWN
boron, dissolved	STAR/EROS
cadmium	
- dissolved (filtered)	STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
calcium	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
carbon	
- inorganic, dissolved	NAQUADAT
- inorganic, total	NAQUADAT, STAR/EROS
- organic, dissolved	NAQUADAT
- organic, total	NAQUADAT, STAR/EROS
- total	STAR/EROS
- particulate	STAR/EROS
carbon dioxide, total	STAR/EROS
carbonate	NAQUADAT
casing	
- diameter	GOWN
- interval	GOWN
- material	GOWN
chlordane	NAQUADAT
chloride	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
chlorophyll A	STAR/EROS
chromium	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
climate zone of grid square	HYDROLOGIC
cobalt	
- extractable (non-filtered)	NAQUADAT, STAR/EROS

	Data Base
- filtered	STAR/EROS
coliforms	
- fecal MF	STAR/EROS
- fecal MPN	STAR/EROS
- MF	STAR/EROS
- MPN	STAR/EROS
- total	NAQUADAT
colour of water	NAQUADAT, STAR/EROS
copper	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
cross-sectional area (river)	HYDROMETRIC
2,4-D (2,4-dichlorophenoxyacetic acid)	NAQUADAT
data, reliability of groundwater	GOWN
DDD (dichlorodiphenyldichloroethane)	NAQUADAT
DDE (dichlorodiphenyldichloroethylene)	NAQUADAT
DDT (dichlorodiphenyltrichloroethane)	NAQUADAT
depth	
- bathythermograph	STAR/EROS
- glacier	GLACIOLOGY
- ice	GLACIOLOGY
- sampling	STAR/EROS
- secchi disc	STAR/EROS
- snow	GLACIOLOGY
- sounding	STAR/EROS
- water	GLACIOLOGY
- water (rivers)	HYDROMETRIC
- well	GOWN
dieldrin	NAQUADAT
discharge	
- annual maximum instantaneous	HYDROMETRIC
- annual maximum and minimum daily	HYDROMETRIC
- daily	HYDROMETRIC
- measurements	HYDROMETRIC
- synthesized mean annual	HYDROLOGIC
distance to sea for grid square	HYDROLOGIC
DO (dissolved oxygen)	NAQUADAT, STAR/EROS
drainage basin areas	HYDROMETRIC
drilling - method	GOWN
elevation	
- average for each grid square	HYDROLOGIC
- ground	GOWN

	Data Base
- method of measurement	GOWN
- measuring point	GOWN
- of southwest corner for each grid square	HYDROLOCIC
endosulfan	NAQUADAT
endrin	NAQUADAT
fluoride	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
forest, area within grid square	HYDROLOGIC
fuel oils	NAQUADAT
gasoline	NAQUADAT
glacier	GLACIOLOGY
- area	GLACIOLOGY
- area within grid square	HYDROLOCIC
- climatic data	GLACIOLOGY
- depth	GLACIOLOGY
- elevation	GLACIOLOGY
- location	GLACIOLOGY
- orientation	GLACIOLOGY
- recession	GLACIOLOGY
- runoff	GLACIOLOGY
- surface changes	GLACIOLOGY
- temperature	GLACIOLOGY
- type	GLACIOLOGY
- velocity	GLACIOLOGY
- width	GLACIOLOGY
hardness, total	NAQUADAT, STAR/EROS
heptachlor	NAQUADAT
housing	
- dwellings connected to sewers	WATERSTAT
- dwellings, number of	WATERSTAT
- dwellings with bath facilities	WATERSTAT
- dwellings with flush toilets	WATERSTAT
- dwellings with municipal water supply	WATERSTAT
- dwellings with other sewage disposal	WATERSTAT
- dwellings with septic tank	WATERSTAT
humic acids	NAQUADAT
hydrocarbons	NAQUADAT

	Data Base
ice	
- depth	GLACIOLOGY
- melt	GLACIOLOGY
- thickness	GLACIOLOGY
iodide, non-filtered	STAR/EROS
iron	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- soluble, total	STAR/EROS
- total	STAR/EROS
jet fuel	NAQUADAT
kerosene	NAQUADAT
labour force	
- average earnings, female	WATERSTAT
- average earnings, male	WATERSTAT
- wage earners, female	WATERSTAT
- wage earners, male	WATERSTAT
lake, area within grid square	HYDROLOGIC
land use, factor for grid square	HYDROLOGIC
lead	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
lignin and tannin	NAQUADAT
lignosulphonates	NAQUADAT
lindane	NAQUADAT
lithium	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
lithologic	
- age precision	GOWN
- material	GOWN
- material age	GOWN
- material interval	GOWN
magnesium	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
manganese	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- soluble, total	STAR/EROS
- total	STAR/EROS
manufacturing industries, establishment	
- latitude	WATERSTAT
- longitude	WATERSTAT

	Data Base
- operating days	WATERSTAT
- shifts for operating day	WATERSTAT
mercury	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- extractable (non-filtered)	NAQUADAT, STAR/EROS
meteorological data, evapotranspiration coefficients	WATERSTAT
methoxychlor	NAQUADAT
mining industries, establishment	
- latitude	WATERSTAT
- longitude	WATERSTAT
- operating days	WATERSTAT
- shifts per operating day	WATERSTAT
- type of mining establishment	WATERSTAT
molybdenum	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
municipal administrative records, total land area	WATERSTAT
municipal waste treatment system	
- average daily flow, by municipalities	WATERSTAT
- plant design capacity	WATERSTAT
- plant effluents	WATERSTAT
- plant influent	WATERSTAT
- population served, by municipalities	WATERSTAT
- total population by municipalities	WATERSTAT
- unit cost of waste treatment	WATERSTAT
municipal water consumption	WATERSTAT
municipal water supply system	
- design capacity	WATERSTAT
- number of outlets, commercial	WATERSTAT
- number of outlets, domestic	WATERSTAT
- number of outlets, industrial	WATERSTAT
- population served	WATERSTAT
- storage capacity	WATERSTAT
nickel	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
nitrate	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS

	Data Base
nitrate and nitrite	
dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
nitrite	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
nitrogen	
ammonia, free, soluble	NAQUADAT, STAR/EROS
organic, filtered	STAR/EROS
- organic, non-filtered	STAR/EROS
total, filtered	STAR/EROS
- total kjeldahl	NAQUADAT, STAR/EROS
total non-filtered	STAR/EROS
total, particulate	STAR/EROS
overburden for grid square	HYDROLOGIC
oxygen	
biochemical demand (BOD)	NAQUADAT, STAR/EROS
chemical demand (COD)	NAQUADAT, STAR/EROS
dissolved (DO)	NAQUADAT, STAR/EROS
dissolved (as % saturation)	STAR/EROS
pcb's (polychlorinated biphenyls)	NAQUADAT
petroleum products	
fuel oils	NAQUADAT
- gasoline	NAQUADAT
jet fuel	NAQUADAT
kerosene	NAQUADAT
pH	
at 25°C	NAQUADAT, STAR/EROS
- at 25°C, integrated sample	STAR/EROS
in situ	STAR/EROS
in situ, integrated samples	STAR/EROS
phenolic material	NAQUADAT, STAR/EROS
phosphorus	
inorganic, dissolved	NAQUADAT
orthophosphate, dissolved (reactive, soluble)	NAQUADAT, STAR/EROS
- reactive (non-filtered)	STAR/EROS
total, non-filtered	NAQUADAT, STAR/EROS
total, filtered (soluble)	NAQUADAT, STAR/EROS
unreactive, soluble	STAR/EROS
potassium	
dissolved (filtered)	NAQUADAT, STAR/EROS
non-filtered	STAR/EROS

	Data Base
residue	
- filtrable	NAQUADAT, STAR/EROS
- non-filtrable	NAQUADAT, STAR/EROS
- total	STAR/EROS
runoff	
- annual maximum and minimum daily	HYDROMETRIC
- daily means	HYDROMETRIC
- daily minima	HYDROMETRIC
- monthly means	HYDROMETRIC
screen	
- diameter	GOWN
- interval	GOWN
- slot size	GOWN
sea, area within grid square	HYDROLOGIC
sediment	
- daily value	SEDIMENT
- deposited density	SEDIMENT
- suspended concentration	SEDIMENT
- suspended, density	SEDIMENT
- suspended, discharge	SEDIMENT
- suspended, particle size distribution of	SEDIMENT
- yield	SEDIMENT
shield factor for grid square	HYDROLOGIC
silica	
- reactive, soluble	NAQUADAT, STAR/EROS
- total	STAR/EROS
slope of grid square	HYDROLOGIC
- azimuth (degrees clockwise from north)	HYDROLOGIC
snow	
- density	GLACIOLOGY
- depth	GLACIOLOGY
- melt	GLACIOLOGY
- climatic data	GLACIOLOGY
- temperature	GLACIOLOGY
snowline	
- date	GLACIOLOGY
- elevation	GLACIOLOGY
sodium	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
soil zone of grid square	HYDROLOGIC

	Data Base
solids, total	
- dissolved	NAQUADAT
- suspended	NAQUADAT
specific conductance	
- 25°C	NAQUADAT, STAR/EROS
- 25°C, integrated	STAR/EROS
standard plate count	
- 20°C	STAR/EROS
- 35°C	STAR/EROS
streamflow	HYDROMETRIC
- synthesized	HYDROLOGIC
streptococci	
- fecal mf	STAR/EROS
- fecal mpn	STAR/EROS
strontium	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
sulphate	
- dissolved (filtered)	NAQUADAT, STAR/EROS
- non-filtered	STAR/EROS
sulphide, non-filtered	STAR/EROS
surfactants	
- linear alkyl sulphonates	NAQUADAT
- nitrilotriacetic acid	NAQUADAT
2,4,5-T (2,4,5-trichlorophenoxyacetic acid) tailing ponds, mining establishments	
- use by mining establishments	WATERSTAT
- volume of waste treated	WATERSTAT
tannin and lignin	NAQUADAT
temperature	
- air	HYDROMETRIC
- glacier	GLACIOLOGY
- precision classification	STAR/EROS
- water	HYDROMETRIC, NAQUADAT, SEDIMENT, STAR/EROS
- water (by bathythermograph)	STAR/EROS
thallium, extractable	NAQUADAT
thermal plants, establishment	
- fuel type	WATERSTAT
- latitude	WATERSTAT
- longitude	WATERSTAT
- operating days	WATERSTAT
- shifts per operating day	WATERSTAT

	Data Base
topography of grid square	HYDROLOGIC
tourists, socio-economic characteristics	WATERSTAT
turbidity	NAQUADAT, STAR/EROS
- from integrated samples	STAR/EROS
urban area within grid square	HYDROLOGIC
vanadium	
- extractable (non-filtered)	NAQUADAT, STAR/EROS
- filtered	STAR/EROS
velocity of water, rivers	HYDROMETRIC
volumetric accumulation	
- of bed load	SEDIMENT
- of deposited sediment	SEDIMENT
water	
- depth	GLACIOLOGY, HYDROMETRIC
- temperature	GLACIOLOGY, HYDROMETRIC
- velocity	GLACIOLOGY, HYDROMETRIC
water discharge	
- by geographic location	WATERSTAT
- by geographic type	WATERSTAT
- by type of establishment	WATERSTAT
- by volume	WATERSTAT
water intake	
- by type of establishment (manu., mining, thermal)	WATERSTAT
- by kind (fresh, brackish)	WATERSTAT
- by location	WATERSTAT
- by source (river, groundwater, etc.)	WATERSTAT
- by volume	WATERSTAT
water levels	
- annual maximum instantaneous	HYDROMETRIC
- daily	HYDROMETRIC
- instantaneous subsurface	GOWN
water pollution abatement expenditures	
- by class (capital, current)	WATERSTAT
- by company (capitalized R & D)	WATERSTAT
- by establishment (fixed capital, repair, operating exp.)	WATERSTAT
- by fiscal year (1972, 1971)	WATERSTAT
- by sector (manu., mining, etc.)	WATERSTAT
water recirculation, make-up water	
- by end use	WATERSTAT

	Data Base
by type of establishment	WATERSTAT
by volume	WATERSTAT
water treatment	
by treatment method	WATERSTAT
by types of establishment	WATERSTAT
by location in production process	WATERSTAT
by volume	WATERSTAT
water use	
by end use	WATERSTAT
by kind of establishment	WATERSTAT
by purpose of bore hole	GOWN
by volume	WATERSTAT
well	
depth	GOWN
plug interval	GOWN
zinc	
dissolved (filtered)	NAQUADAT, STAR/EROS
extractable (non-filtered)	NAQUADAT, STAR/EROS

13.0 Addresses for Enquiries

13.1 General

Requests for information, except where otherwise indicated, should be directed to the appropriate division or section at the following address:

Inland Waters Directorate,
Environment Canada,
Ottawa, Ontario K1A 0E7

The divisions, sections, other offices and telephone numbers for the respective data bases are given below.

13.2 Physiographic Data

Network Planning and Forecasting Section,
Applied Hydrology Division, Inland Waters Directorate.
(Telephone: 819-997-1509)

13.3 Streamflow and Water Level

Data Control Section,
Water Resources Branch,
Inland Waters Directorate.
(Telephone: 819-997-2098)

OR

District Engineer, Water Survey of Canada, at:

Room 502,
1001 West Pender Street,
Vancouver 1, British Columbia.
(Telephone: 604-666-3606)

(British Columbia and Yukon Territory)

700 Calgary Power Building,
110 - 12th Avenue, S.W.,
Calgary 3, Alberta.
(Telephone: 403-266-1631)

(Alberta and North-west Territories)

G.M.C. Building,
1102 - 8th Avenue,
Regina, Saskatchewan.
(Telephone: 306-525-0148)

(Saskatchewan)

521 Federal Building,
269 Main Street,
Winnipeg 1, Manitoba.
(Telephone: 204-985-2434)

(Manitoba, Ontario and Northwest Territories)

Federal Building,
75 Farquhar Street,
Guelph, Ontario.
(Telephone: 519-821-0110)

(Ontario)

Area Engineer,
Water Survey of Canada,
Shea Building,
2180 Belgrave Avenue,
Montreal 261, Quebec.
(Telephone: 514-487-5933)

(Quebec)

5th Floor, Gulf Building,
6009 Quinpool Road,
Halifax, Nova Scotia.
(Telephone: 902-426-3770)

(New Brunswick, Nova Scotia and Prince Edward Island)

13.4 Sediment

Sediment Survey Section,
Water Resources Branch,
Inland Waters Directorate.
(Telephone: 819-997-1185)

OR

District Engineer,
Water Survey of Canada.
(see district office addresses given above)

13.5 Groundwater

GOWN Program Co-ordinator,
Groundwater Section,
Hydrology Research Division,
Inland Waters Directorate.
(Telephone: 819-997-2466)

13.6 Glaciology

Glaciology Division,
Inland Waters Directorate.
(Telephone: 819-997-2476)

OR

Special Services and Surveys Section,
Applied Hydrology Division,
Inland Waters Directorate.
(Telephone: 819-997-1934)

13.7 The Great Lakes

Data Archives Unit,
Data Management Section,
Scientific Operation Division,
Canada Centre for Inland Waters,
P.O. Box 5050,
Burlington, Ontario.
(Telephone: 416-637-4292)

13.8 Water Quality

Head,
Data and Instrumentation Subdivision,
Network and Surveys Division,
Water Quality Branch,
Inland Waters Directorate.
(Telephone: 819-997-3422)

13.9 Use of Water Resources

Water Resources Data System,
Inland Waters Directorate.
(Telephone: 819-997-2329)

13.10 Planning and Management (Scientific Documentation)

Water Resources Data System,
Inland Waters Directorate.
(Telephone: 819-997-2324)

For Literature Searches call collect 819-997-1238.

14.0 Inland Waters Directorate Data Publications

14.1 Streamflow and Water Level

"Surface Water Data", 1965 to 1971: annual publications for British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Yukon Territory - Northwest Territories, and Atlantic provinces.

"Water Resources Paper": surface water data for 1908-1964.

"Surface Water Data Reference Index", published annually.

"Historical Streamflow Summary", to 1970: issued every five years.

14.2 Sediment

"Sediment Data for Canadian Rivers", 1965 to 1969: annual publication. Data collected for 1961-64 published in "Water Resources Papers" Series.

IHD Project, Saskatchewan - 1, "A Study for Aggradation and Degradation of the South Saskatchewan River, Gardiner Dam - Saskatoon": progress reports, 1964-67 (every five years); annual data report, 1968, 1969, 1970 and 1971.

IHD Project, Saskatchewan - 2, "Delta Formation and Sedimentation in Lake Diefenbaker": progress report, 1964-67 (every five years); annual data reports, 1968, 1969, 1970 and 1971.

"Hydrometric and Sediment Survey, Lower Fraser River": progress report, 1965-68 (every five years).

Reports of other reservoir and watershed studies are also available.

14.3 Groundwater

Some data related to specific studies are published in the Scientific Series and Technical Bulletin Series of the Inland Waters Directorate.

14.4 Glaciology

Report Series:

No. 4 - "Glacier Survey in Alberta, 1968".
No. 5 - "Glacier Survey in British Columbia".
No. 10 - "Glacier Survey in British Columbia, 1968".

Technical Bulletin Series:

No. 37 - "Glacier Inventory of Canada - Axel Heiberg Island, NWT, 1969".

Glacier Inventory Notes:

No. 1 - "Glaciers in Canada". Photographs and manuscripts held by the Scott Polar Research Institute, Cambridge, England. 1970

No. 2 - "Photographs of Glaciers in Western Canada" held by the Royal Geographical Society, Kensington Gore, London, England. 1970

No. 3 - "Photographs of Glaciers in British Columbia" held by the Film and Photographic Branch, Department of Travel Industry, British Columbia. 1971

No. 4 - "Information booklet for the Inventory of Canadian Glaciers". 1971

No. 5 - "C.D. Walcott's Panoramas of Western Canada". 1971

No. 6 - "Glacier Surveys by District Personnel of the Water Survey of Canada, 1. The Victoria Glacier". 1971

No. 7 - "Glacier Surveys by District Personnel of the Water Survey of Canada, 2. Peyto Glacier". 1972

Water Survey of Canada:

"Glacier Surveys in Alberta, 1971".
"Survey of Glaciers on the Eastern Slopes of the Rocky Mountains in Banff and Jasper National Parks, 1968".

14.5 The Great Lakes

Limnological Data Report Series:

1966, 1967, 1968, 1969. Canada Centre for Inland Waters, Burlington, Ontario.